A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

DECEMBER, 1936.

GENERAL PHYSICS.

ADSORPTION.

5320. Polymolecular Adsorbed Films. Part I. Adsorption of Argon on Salt Crystals at Low Temperatures, and Determination of Surface Fields. R. S. Bradley. *Chem. Soc., J. pp.* 1467–1474, *Oct.*, 1936.—A is adsorbed in thick films on salt crystals, the positive ions of which are much smaller than the negative ions (*e.g.*, $CuSO_4$, $Al_2 (SO_4)_3$), but no adsorption is observed with salts having positive and negative ions of approximately the same size, *e.g.*, KCl. The property of adsorbing appears to be associated with a tendency to form coordinate and covalent links due to the incomplete electronic shell of the kation. The theory of formation of thick films is discussed and an expression is deduced giving the pressure of gas in equilibrium with an adsorbed film. W. R. A.

5321. Disappearance of Carbon Monoxide in the Presence of Electrically-Heated Nickel Filaments. G. Bryce. *Chem. Soc., J. pp.* 1513–1517, *Oct.*, 1936.—Processes by which Ni filaments might clean up CO are studied and new methods developed to identify and examine them. It is found that CO is cleaned up by Ni at temperatures above 1200° K., two molecules of gas disappearing per metal atom evaporated. The properties of the product (volatility, decomposition, and reaction with CO) are investigated, and it is shown to be stable at − 190°. but to decompose completely at 100°. The gas was adsorbed on the Ni as this condensed on the bulb. A similar mechanism was indicated for the clean-up of CO by Mo above 1900° K. Neither N_2 nor CO was affected by hot Ni under similar conditions. H. H. Ho.

5322. Adsorption of Hydrogen and of Deuterium by Platinum. E. B. Maxted and C. H. Moon. *Chem. Soc., J. pp.* 1542–1546, *Oct.*, 1936.—The apparatus employed was the same as that used for ethylene [see Abstract 4430 (1936)], save that a simple bulb containing 15·2 gm. of Pt-black was substituted for the calorimeter illustrated. The adsorption of H-ions, at each temperature, is found to be considerably faster than that of the D-ions. The degree of conformity of the kinetics of the adsorption of H_2 to the equation $\log a/(a - x) = kt^n$ was very striking. There was no kinetic evidence for an adsorption phase involving the immediate adsorption of any considerable bulk of gas and distinct from the process which is apparently complete within a few minutes after the admission of H_2. The subsequent far slower adsorption, after the completion of the stage corresponding with the linear portion of the graph, may be due to a distinct secondary process, *e.g.*, of solution, or to the attainment of a stage at which the smaller Pt particles are saturated. In any case the total adsorption process is not complete even after many weeks. The adsorption of D_2 followed a path identical in form with that of H_2. H. H. Ho.

5323. Adsorption of Vapours on Glass Spheres. Part I. Nitrogen. J. L. Shereshefsky and C. E. Weir. *Am. Chem. Soc., J.* 58. *pp.* 2022–2029, *Oct.*, 1936.—The thermal flow effect of H_2 and He is determined and found to agree at pressures corresponding to equal mean free paths. The activation of glass surfaces is studied under different conditions. The adsorption of N_2 on glass spheres at liquid-air temperatures is studied. Different degrees of packing of the spheres is found to have no effect on the adsorption. Similar to O_2 the adsorption isotherm of N_2 at low pressures shows the unusual phenomenon of recession of the equilibrium pressure. A possible explanation for this behaviour is suggested. The application of various adsorption theories to the data is discussed. AUTHORS.

5324. Heat of Adsorption of Carbon Monoxide on Copper at − 183°. R. A. Beebe, G. W. Low, Jr., and S. Goldwasser. *Am. Chem. Soc., J.* 58. *pp.* 2196–2199, *Nov.*, 1936.—A method is described for the direct measurement of the differential heats of adsorption of CO on Cu at − 183°. The differential heats are of the order of 8 k.cal./mol. in the initial stages, and decrease to 3 k.cal. in the later stages of the adsorption. The results seem to indicate that a considerable part of the adsorption for the initial increments of gas is of the activated type even at the low temperature of − 183°. AUTHORS.

5325. Discontinuities in the Sorption Process. A. G. Foster. *Faraday Soc., Trans.* 32. *pp.* 1559–1569, *Nov.*, 1936.—Isothermals of CCl_4 on two samples of silica gel are determined at 25° C., using a static vacuum method. The effect of heat treatment and flushing out is examined, but no well-defined discontinuities are observed under any conditions. After prolonged heating at 120° C. with CCl_4, some of the residual water is removed from the gel, and a marked alteration occurs in the shape of the isothermal, resulting in greatly increased adsorption at low pressures. The dynamic retentivity method is used to determine isothermals of water, ethyl alcohol and CCl_4 on silica gel. A comparison of the results with those obtained by the static technique shows that the retentivity method is quite unreliable when applied to isothermals of abnormal type. AUTHOR.

***5326. Monomolecular Adsorption Layers and Surface Films. Part I. A. S. Achmatow.** *Kolloid Zeits.* 77. *pp.* 20–26, *Oct.*, 1936.—An electromagnetic tensiometer is described in which the 2-dimensional pressure acting on a float in a surface film is balanced against electromagnetic forces. A feature of the apparatus is that there are no hysteresis effects. P. H. B.

See also Abstract **5444.**

ATOMIC AND MOLECULAR STRUCTURE.

5327. Simple Model of the Nucleus. K. Bechert. *Zeits. f. Physik,* 103. 3–4. *p.* 276, 1936.—Corrections to the original paper [see Abstract 4434 (1936)].

5328. Scattering of Protons by Protons. M. A. Tuve, N. P. Heydenburg and L. R. Hafstad. *Phys. Rev.* 50. *pp.* 806–825, *Nov.* 1, 1936.—By counting several thousand scattered protons at different angles and voltages with a linear amplifier the numbers of protons scattered or projected by recoil through angles from 15° to 45° from a carefully defined mono-energetic proton beam in passing through 2 mm. path length of pure H_2 gas at a pressure of 12 mm. have been measured for proton beam energies of 600, 700, 800, and 900 kV. The angular resolution for the slit systems was about 2°. At 600 kV the observed numbers at all angles are roughly 2/3 of the values predicted by Mott's formula. The curves for this observed " Mott ratio " *v.* angle change progressively as the voltage is increased and at 900 kV the observations show 2/3 of the Mott value at 15°, 1·4 at 30° and 4·0 at 45°. The results are ascribed to a proton-proton interaction at close distances which involves a marked departure from the ordinary Coulomb forces. The observed curves lead quantitatively to a simple theoretical interpretation on the basis of wave-mechanics as shown by Breit, Condon and Present [see following Abstract].

F. C. C.

5329. Theory of Scattering of Protons by Protons. G. Breit, E.U. Condon and R. D. Present. *Phys. Rev.* 50. *pp.* 825–845, *Nov.* 1, 1936.—The experiments of Tuve, Heydenburg and Hafstad [see preceding Abstract] are discussed from the standpoint of the standard theory of scattering in central fields. The theoretical formulæ are presented in a form convenient for numerical computation and are supplemented by tables. The difference between the observed scattering and that to be expected according to Mott's formula which uses the inverse square law can be explained by using the phase shift in the partial waves having angular momentum L=0. The variation of the scattering anomaly with proton energy is in approximate agreement with that to be expected from an interaction potential independent of the energy. The values obtained are in good agreement with those found by Feenberg and Knipp and by Bethe from the mass defects of H^2, H^3, He^4 provided the mass defect calculations are made on the basis of a proton-neutron interaction which depends on the relative orientation of the spins of proton and neutron. The "like-particle" interaction for a Gauss error potential is $39\, mc^2 e^{-17r^2}$ with $8{\cdot}97 \times 10^{-13}$ cm. as the unit of length and the interaction energy is 11·1 eMV. for a potential which is constant, except for its Coulombian part, within a distance $e^2/mc^2 = 2{\cdot}82 \times 10^{-13}$ cm. Close agreement is found between the empirical values of the proton-proton and proton-neutron interactions in ^1S states and it is suggested that apart from Coulombian and spin effects the interactions between heavy particles are independent of their charge and the apparent preference for equal numbers of protons and neutrons in the building up of nuclei is conditioned more by the operation of the exclusion principle than by the greater values of proton-neutron forces.

F. C. C.

5330. Nuclear Forces. B. Cassen and E. U. Condon. *Phys. Rev.* 50. *pp.* 846–849, *Nov.* 1, 1936.—The various types of exchange forces that are being used in current discussions of nuclear structure may all be simply expressed in terms of a formalism which attributes five coordinates to each "heavy" particle and applies the Pauli exclusion principle to all the particles in the system. The simplest assumption for the interaction law is that which implies equality of proton-proton and neutron-neutron forces and also equality with the proton-neutron forces of corresponding symmetry. This is in agreement with present empirical knowledge of these interactions.

F. C. C.

5331. Interaction Between Nuclear Particles. G. Breit and E. Feenberg. *Phys. Rev.* 50. *pp.* 850–856, *Nov.* 1, 1936.—Experimental evidence pointing to a universal form of interaction for all nuclear particles is reviewed. The form $V_{ij} = \{(1-g-g_1-g_2)P_{ij}^M + gP_{ij}^H + g_1 \cdot 1 + g_2 P_{ij}^S\} J(r_{ij})$, where g, g_1, g_2 are constants and P^M, P^H are the Majorana and Heisenberg exchange operators, while $P^S = P^M P^H$ is the operator proposed by Bartlett which exchanges the spins without affecting the coordinates, is discussed. It is found to be satisfactory for H^3, He^3, He^4 considered together with proton and neutron scattering. The simplest form of interaction energy satisfying all present requirements is obtained by putting $g_1 = g_2 = 0$. F. C. C.

5332. Nuclear Disintegration Using Ra(B+C) as Source of Radiation. E. Fischer-Colbrie. *Akad. Wiss. Wien. Ber.* 145. 2*a*. 5. *pp.* 283–300, 1936.—Using a valve counter the protons liberated from N_2 when bombarded by *α*- particles from Ra(B+C) are counted. Two groups of protons are detected. The energy emissions corresponding to the two groups are −2·8 and −1·4 eMV. respectively. The difference between the energies corresponds to the hardness of the *γ*-radiation emitted during the disintegration. Two energy levels by which *α*-particles can enter the N_2 nucleus are observed. J. E. R. C.

***5333. Atomic Disintegration Technique. J. Thibaud.** *R.G.E.* 40. *pp.* 427–434, *Oct.* 3, 1936.—The author describes the apparatus and technique used for detecting charged particles and the application of this to a study of positive electrons, neutrons, cosmic radiation and atomic transmutations. The apparatus described is mainly that of the Institut de Physique atomique de la Faculté des Sciences de Lyon. J. E. R. C.

5334. Transmutation of Matter by High-Energy Particles and Radiations. J. D. Cockcroft. *I.E.E., J.* 79. *pp.* 532–540, *Nov.*, 1936. *Kelvin Lecture.*—Detailed account of recent work on the transmutation of nuclei by fast positive ions. Summary of work on artificial radioactivity and on transmutations produced by neutrons and *γ*-rays. R. P.

5335. Content of Deuterium in Light Hydrocarbons of Various Petroleums. A. Maillard. *Comptes Rendus*, 203. *pp.* 804–806, *Oct.* 26, 1936.—By condensing the exhausts when using the oil concerned in an internal-combustion engine 25l. of water were collected for each oil examined. This after purification was reduced by electrolysis to 5 cc. and the content of D_2O determined from the melting point and refractive index. The amounts of D in Pechelbronn and in Peru petroleum were thus determined as 0·94 and 0·72 per mil respectively, or approximately double that of ordinary tap water. The amount also appears to vary with the origin of the petroleum. C. A. S.

5336. Difference in Atomic Weight of Oxygen from Air and from Water. E. R. Smith and H. Matheson. *Bureau of Standards, J. of Research*, 17. *pp.* 625–628, *Oct.*, 1936.—Water formed by burning commercial electrolytic H_2 with atmospheric O_2 was found to have a density greater by 8·6 p.p.m. than that of ordinary water. The difference in density was confirmed by an independent method, which involved the utilisation of H_2 and O_2, having practically the same isotopic composition as in normal water, such being evolved after prolonged electrolysis until an equilibrium state is attained in a small commercial electrolyser. A comparison of the water formed by burning together the electrolysed H_2 and atmospheric O_2 with the water formed by recombining the gases from the electrolyser, again yields the difference between atmospheric and aqueous O_2. This difference is also obtained by comparison of the water formed by burning together tank H_2 and atmospheric O_2 with the water formed by burning H_2 from the same tank with O_2 from the electrolyser. The measured difference in density corresponds to a difference of $0{\cdot}0001_4$ atomic weight unit between the atomic weights of atmospheric and aqueous O_2. H. H. Ho.

5337. Absorption of Neutrons in Ag, Cd and B. N. Dobrotin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 291–293, 1936. *In English.*—Continuing some previous work [see Abstract

4696 (1935)] the author studies firstly the variation of the absorption of neutrons by B after filtration through various thicknesses of paraffin; secondly, the absorption in Ag of neutrons filtered through Cd in relation to the thickness of paraffin; and thirdly, the relation between the activities of the two Ag isotopes for neutrons which have passed through filters of Cd and B and also different thicknesses of paraffin. G. O. B.

5338. Slowing Down of Neutrons by a Thin Plate. H. Yukawa. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 507–518, *Oct.*, 1936. *In English.*—The energy distribution of neutrons slowed down by a thin plate containing H, whose thickness is small compared with the mean free path of the incident neutrons of definite energy, is calculated for the following cases, taking only the single and the double scatterings into account: (i) Normal incidence. In this case, the distribution functions for low neutrons increase with decreasing energy E as $-\log E$. (ii) A point source. In this case, the distribution function is nearly constant. (iii) A point source and a small detector placed face to face on either side of the plate. In this case also, the distribution function of neutrons, which hit the detector after single scattering, is nearly constant. This result is compared with experiment. AUTHOR.

5339. Slowing Down of Neutrons by Nuclei of Heavy Elements. P. I. Lukirsky and T. Careva. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 9. *pp.* 411–412, 1936. *In English.*—Rn+Be (300 millicuries) was placed at the centre of a Pb Sphere (7·4 cm. dia.). The sphere was covered with a uniform layer of paraffin, and the radioactivity produced in a Ag target outside compared (*a*) with the whole at normal temperature, and (*b*) with the paraffin preliminarily cooled in liquid air. The activity with (*b*) was 23% more than with (*a*). This is doubtless to some extent due to the cooling of the Pb and some of the neutrons, but certainly not entirely. The greater part is to be explained by the formation of slow neutrons when passing through the Pb, fast ones being captured thereby and slow ones subsequently emitted [see Abstract 2478 (1936)]: these then undergo a temperature effect in the paraffin. C. A. S.

5340. Activation of Thulium by Slow Neutrons. M. Curie and P. Preiswerk. *Comptes Rendus*, 203. *pp.* 787–788, *Oct.* 26, 1936.—Thulium oxalate (containing about 5% Yb, 2% Dy, and 1% of each of Lu, Ho and Tb) was irradiated for three days with neutrons from 500 millicuries of Rn+Be in paraffin. The radioactive products observed were one with period 3±0·5 hrs., due probably to impurities, *i.e.*, Dy and Yb; and another with period of about 8 months, thought to be due to $^{169}_{69}\mathrm{Tu}+^{1}_{0}n\rightarrow^{170}_{69}\mathrm{RdTu}$, which probably loses an electron to form $^{170}_{70}\mathrm{Yb}$, itself probably unstable. C. A. S.

5341. Energy Liberated at Neutron Capture. R. Fleischmann. *Zeits. f. Physik*, 103. 1–2. *pp.* 113–124, 1936.—At the capture by a nucleus of a slow neutron with formation thereby of an isotope of the capturing element, the binding energy is liberated as γ-radiation. In this paper the author deals with the subject of determining the quantum energy of this γ-radiation by employing the coincidence method, in which two counting chambers are used to make absorption measurements on the photo- and recoil-electrons and on the electron pairs produced by the γ-rays in Al. Eleven substances are studied. Graphs are given of the quantum energies of the γ-rays emitted by them on capture of a slow neutron. Plotted against the atomic numbers, these energies show a maximum at Fe, a minimum in the region of the rare earths and a further rise at higher atomic numbers. A comparison is made between this curve and a curve of the mean effective cross-sections for neutron capture obtained from some results of Dunning and others. It is shown that the results are in agreement with Bohr's theory of reciprocal nuclear action, and the theory of the spacing of nuclear levels. Special attention is paid to the cases of Cd and Ag. G. O. B.

5342. Theory of Orbital Neutrons. G. N. Lewis. *Phys. Rev.* 50. *pp.* 857–860, *Nov.* 1, 1936.—As an alternative to present theories of the capture of slow neutrons by atoms, it is suggested that such capture is not primarily a phenomenon affecting the interior of the nucleus, but rather that, owing to the interaction between the spin of the nucleus and the spin of the neutron, there is a field outside the nucleus in which neutrons can be held in quantised " orbits." The fall from one of these orbits into the centre of the nucleus is regarded as a second phenomenon not immediately related to the first. The probability of capture in a particular orbit is assumed to depend (1) upon a relationship between the energy of the approaching neutron and the kinetic energy in this orbit, and (2) upon the presence in the same neighbourhood of occupied electronic orbits. Some consequences are drawn from these assumptions and compared with the results of experiment. AUTHORS.

5343. Maximum Valency of Elements and the Melting Temperatures of Simple Substances. B. Ormont. *Acta Physicochimica,* 5. 3. *pp.* 405–416, 1936. *In German.*—This paper is supplementary to the author's previous publications [see Abstract 2481 (1936)] and deals with the work of Friedrich and Sittig which is now criticised. The result is established that the melting points of simple substances with a metallic and atomic lattice vary, to a first approximation, with the average magnitude of the maximum valency attained with respect to F and Cl. H. H. Ho.

5344. Molecular Structures of Methyl Derivatives of Si, Ge, Sn, Pb, N, S and Hg. L. O. Brockway and H. O. Jenkins. *Am. Chem. Soc., J.* 58. *pp.* 2036–2044, *Oct.,* 1936.—By electron diffraction investigation of the gases, the structures of certain methyl compounds are determined. Four tetramethyls with tetrahedral symmetry have the following bond distances: $Si - C = 1{\cdot}93 \pm 0{\cdot}03$ Å, $Ge - C = 1{\cdot}98 \pm 0{\cdot}03$ Å, $Sn - C = 2{\cdot}18 \pm 0{\cdot}03$ Å, $Pb - C = 2{\cdot}29 \pm 0{\cdot}05$ Å. Nitrogen trimethyl has a bond angle of $108 \pm 4°$ with $N - C = 1{\cdot}47 \pm 0{\cdot}02$ Å. In sulphur dimethyl and mercury dimethyl the interatomic distances are $S - C = 1{\cdot}82 \pm 0{\cdot}03$ Å. and $Hg - C = 2{\cdot}20 \pm 0{\cdot}10$ Å, respectively. These distances agree with the sums of covalent radii given by Pauling and Huggins [see Abstract 879 (1934)]. In a discussion of previous data for the chlorides it is shown that relative electronegativities (or the existence of electric moments in the bonds) are not responsible for the shortening observed in some of the chlorides. This effect is instead probably due to the contribution of structures having double electron pair bonds. Further investigation is required to explain the observed deviations in the chlorides. AUTHORS.

5345. Molecular Size Distribution in Linear Condensation Polymers. P. J. Flory. *Am. Chem. Soc., J.* 58. *pp.* 1877–1885, *Oct.,* 1936.—Equations expressing the weight fraction, number, and mole fraction of each molecular species in a linear condensation polymer are derived on the basis of simple and not improbable assumptions. The characteristics of these functions are demonstrated and discussed. The number-average, weight-average and Z-average molecular weights of Lansing and Kraemer are shown to be in the ratio 1 : 2 : 3 for the high molecular weight polymers. The bearing of this result on Staudinger's method for determining molecular weights is discussed. The special case of polymers prepared by the condensation of non-equivalents of two bi-functional reactants (A − A + B − B) is analysed and shown to conform to a distribution similar to the above. Other special cases can be subjected to a similar analysis. AUTHOR.

5346. Trends in Modern Physics. A. Ferguson. *Science*, 84. *pp*. 401–407, *Nov*. 6, 1936. *Nature*, 138. *pp*. 785–789, *Nov*. 7, 1936.—*Paper read before the British Assoc., Blackpool, Sept.*, 1936.

See also Abstracts 5322, 5387, 5388, 5438, 5496, 5497, 5500, 5553, 5572, 5573, 5574, 5609.

COLLOIDS.

5347. Electrolytic Coagulation of Weak Solvated Sols and Electrolytic Activity. Part V. H. A. Wannow. *Kolloid Zeits*. 77. *pp*. 46–53, *Oct*., 1936.—The rate of increase of opacity of As_2S_3 sols on the addition of electrolytes is measured by a Zeiss gradation photometer in combination with the opacity measurer. The curves obtained are in agreement with those of other workers. A phenomenon previously unrecognised has, however, been established, namely, that the maximum opacity is strongly dependent on the valency of the dominant ions. The opacity is strongest for KCl (*e.g.*, 459), then follows $MgCl_2$ (*e.g.*, 301) and the smallest values are obtained for $AlCl_3$ and $ThCl_4$ (*e.g.*, 169 and 183). The application of nephelometric measurements to the determination of coagulation values is also discussed. [For Part IV see Abstract 4458 (1936).] J. K.

5348. Moving Boundary Method of Measuring Cataphoresis. J. J. Bikerman. *Faraday Soc., Trans*. 32. *pp*. 1648–1652, *Nov*., 1936.—Experimental investigations are made of an improved method of measuring cataphoresis based on the observing the movement of a boundary between two almost identical sols of different colours. AUTHOR.

5349. Non-Spherical Nature of Colloidal Particles in Relation to the Formation of Jelly Structure. S. Prakash. *Indian Acad. Sci., Proc*. 4*A*. *pp*. 332–344, *Sept*., 1936.—Non-spherical colloidal particles orient themselves under the action of mechanical, electrical and magnetic stresses, *i.e.*, their sols exhibit stream, electrical and magnetic bi-refringence. The author studied the magnetic bi-refringence of sols of mercurisulphosalicylic acid. While such sols exhibit marked magnetic bi-refringence, which is reduced by peptising agents and by halide ions and increased by certain other anions, it is concluded that the presence of non-spherical particles is not an essential pre-requisite for jelly formation, as many jelly-forming sols do not exhibit magnetic bi-refringence. L. V. C.

5350. "Spinnability" of Solutions of Lyophile Colloids and Mechanical Properties of the Spun Threads. Part II. H. Erbring. *Kolloid Zeits*. 77. *pp*. 32–36, *Oct*., 1936.—The spinnability [see Abstract 4466 (1936)] of 15 % solutions of cellulose acetate in a mixed solvent (acetone-ethyl alcohol) passes through a minimum as the proportion of alcohol is increased and later rises to a maximum. The viscosity follows the same course, but coagulation of the cellulose acetate occurs at 30 % alcohol, immediately after the maximum spinnability. As previously concluded, the latter is seen once more as a transition phenomenon. The breaking strength and extension of the fibres so produced (after coagulation by evaporation of solvents) are at a maximum when no alcohol is employed. L. V. C.

5351. Structure of the Water Envelope in Micelles of Organic Colloids. K. Hess and J. Gundermann. *Zeits. f. phys. Chem.* 34. *Abt.B.* 1–2. *pp.* 151–157, 1936.—The authors refute the suggestion that the X-ray diffraction diagrams obtained with celluloses, starches, etc., are attributable largely, if not solely, to multimolecular directed layers of water bound to the micelle surfaces. Certain of the lines found with natural cellulose and with cellulose hydrate correspond closely with those to be expected from ice, but the latter would also give lines which are totally absent in the former cases. Moreover, natural cellulose (ramie fibre) gives essentially the same diffraction pattern whether dried in hydrogen at 155–160° C. or, at the other extreme, immersed in water. L. V. C.

5352. Photoelectric Measurement of Sedimentation. C. Enders and A. Spiegl. *Kolloid Zeits.* 77. *pp.* 37–38, *Oct.*, 1936.—It is noted that measurements of absorption with a photoelectric colorimeter give curves for rate of sedimentation similar to those obtained by kinetic methods. The optical method has the advantage of requiring considerably less material. L. A. W.

5353. Colloid Chemical Phenomena in Metals. Part III. J. A. Kljatschkó. *Kolloid-Beihefte*, 44. 8–12, *pp.* 387–426, 1936.—The fundamental problems of present-day metallurgy are briefly discussed, particular attention being paid to the properties and structure of fluid metals, deformation of solid metals, recrystallisation and ageing. The inadequacy of the classical concepts in interpreting many of these problems is demonstrated. The hypotheses of Smekal and Zwicky concerning the real structure of crystals are criticised and a micellar hypothesis is developed to account for the structure of fluid and solid metals and alloys which has none of the objections of the former theories. It is assumed that the building up of a metal crystal takes place by two distinct types of binding (primary and van der Waals type) and that there are two types of inner surface: (*a*) an inter-micellar and (*b*) an intra-micellar surface. This hypothesis is useful for solving other important problems, and a number of examples are given. The colloid phenomena in metals are finally subdivided into 3 systems: (*a*) metal-metal, (*b*) metal-non-metal, and (*c*) miscellaneous, examples of which have been given [see Abstract 34 (1936)]. H. J. H. S.

See also Abstracts 5447, 5520, 5603, 5631, 5632, 5634, 5665, 5693, 5696.

CRYSTAL STRUCTURE AND PROPERTIES.

5354. Physical Properties of Crystals. A. Ganguli. *Current Science.* 5. *pp.* 128–130, *Sept.*, 1936.—The most characteristic feature of a crystal is its geometrical form which is determined by the internal-bonds between the various units in the lattice. The crystal structure is one of minimum potential energy and is thermodynamically the most stable one. The properties of crystals as predicted by theory are not always borne out by experiment, and several anomalies have been observed. The existing theories of crystals include: (1) mosaicity due to flaws and other causes, (2) Griffith's theory of cracks, (3) internal adsorption. Each of these is shortly discussed. G. E. A.

5355. Veining and Mosaic Structure in Metals. L. Northcott. *Engineer* (*Metallurgist*), 162. *pp*. 165–167, *Oct*. 30, 1936.—The phenomena of veining is associated with the precipitation of small quantities of oxides from solid solution. The solubility decreases with temperature. The current theories of mosaic structures are discussed. F. I. G. R.

5356. Structure of Al, Cr and Cu Films Evaporated on Glass. R. Beeching. *Phil. Mag*. 22. *pp*. 938–950, *Nov*., 1936. *Supplement*.—It is shown that thin films of Al, Cr and Cu consist mainly of the oxides, although these oxides have not their usual crystal forms. It seems probable in the case of Al that the oxide is related to γAl_2O_3. The oxides formed on Al and Cr after heating to 250° C have the same structure and almost the same spacing. Thick films are apparently pure metal on the surface. The conditions under which the films are produced are also discussed. The readiness with which oxide layers form on the films at 250° suggests that there is a good deal of O_2 trapped in the films themselves. The most likely explanation of the presence of an oxide film on the glass would seem to be that the gas is liberated from the glass itself under the bombardment by the metal atoms. Far thicker oxide layers form than would be the case with the metal in its ordinary state. This is especially true of Al and Cr films. C. J. B. C.

5357. Theory of Equilibrium in Alloys. W. Hume-Rothery. *Phil. Mag*. 22. *pp*. 1013–1047, *Nov*., 1936. *Supplement*.—A theoretical discussion of the equilibrium diagram from a non-thermodynamic standpoint, with special reference to electron concentration, lattice constants, formation of intermetallic compounds, phase boundaries, lattice distortion, heat of formation, under the following heads—(1) Introduction; (2) Relation between electron concentration and lattice distortion for the Cu α and Ag α boundaries; (3) The three types of ternary solid solubility isotherms—Alloys of Al with Mg and Si; alloys of Zn with Al and Cu; Ag alloys with Sn and Be; Ag alloys with Cd and Cu; solubility limits of intermetallic compounds in ternary alloys; crystallisation of Mg_2Si from Al alloys and of the θ phase (Ni_3Sn or Ni_4Sn) from bronzes. [See Abstracts 2353 (1934) and 3420 (1936.] D. R. H.

5358. X-Ray Investigation of the Mn-Sb System. F. Halla and H. Nowotny. *Zeits. f. phys. Chem*. 34. *Abt.B*. 1–2. *pp*. 141–144, 1936.—The system is investigated by the powder method. Apart from the known compound MnSb with NiAs structure, the presence of a tetragonal Mn_2Sb lattice is established, isomorphous with Fe_2As and Cu_2Sb. Space group D^7_{4h}, $a = 4 \cdot 08$, $c = 5 \cdot 56$Å. D. R. H.

5359. Structure of Cu_2Sb and Fe_2As. M. Elander, G. Hägg and A. Westgren. *Arkiv f. Kem. Min. och Geologie, Stockholm*, 12B. *No*. 1. *pp*. 1–6, 1936. *In English*.—A new investigation of these two compounds is made with the X-ray powder method. The parameters of each atom in the tetragonal unit cell of each compound are tabulated. It is found that the interatomic distances in the lattices are different from those calculated from the accepted values of atomic radii. It is suggested that this anomaly is due to a polarisation effect. J. I.

5360. Structure of Ammonium Bromide at Low Temperatures. J. Weigle and H. Saini. *Helv. Phys. Acta*, 9. 7. *pp*. 515–519, 1936. *In French*.—X-ray powder photographs were taken with filtered CuK_α radiation in a vacuum spectrograph of the Seeman-Bohlin type in the temperature range −40° C. to −71·5° C. The cubic form of β NH_4Br, stable between −40° C. and 180° C. undergoes slight deformation into a tetragonal form, γ NH_4Br, stable below −40° C. The change from one form to the other may be regarded as a contraction of two of the cubic axes by 3 parts in 1000, and by a 2% displacement of the Br ions along the third axis in alternatively a positive and a negative direction with respect to the two shortened axes. The results fit the contraction observations made upon crystals by Simon and Bergmann. It is suggested that the study of cubic crystals which undergo transformation into tetragonal modifications may elucidate the mosaic crystal problem, for it may be postulated either that the unchanged cubic axis is parallel throughout the single crystal or, if the single crystal is built up of mosaic blocks, that the unchanged edge of the cells is distributed at random between the three axes in different mosaic blocks throughout the single crystal. W. H. Ge.

5361. Structure of Alkali-Tungsten-Chlorides. C. Brosset. *Arkiv f. Kem. Min. och Geologie, Stockholm,* 12A. No. 4. *pp.* 1–8, 1936. *In German.*—The detailed structure of $K_3W_2Cl_9$ is given and the lattice parameters of four other tungsten chlorides. The crystals are hexagonal with the following cell dimensions,

	$K_3W_2Cl_9$	$(NH_4)_3W_2Cl_9$	$Rb_3W_2Cl_9$	$Cs_3W_2Cl_9$	$Tl_3W_2Cl_9$
a (Å)	7·16	7·16	7·24	7·35	7·15
c (Å)	16·17	16·17	16·95	17·06	16·33

There are 2 mol. per unit cell and the space group is C_{6h}^2. A table is given showing the comparison of the observed intensities of X-ray reflection from the potassium compound with those calculated on the basis of the proposed structure. It is found that the group W_2Cl_9 exists as a distinct entity and the structure may be regarded as a hexagonal close-packing of W_2Cl_9 ions with the K ions occupying the interstices. J. I.

5362. Symmetry and Structure of Manganite, Mn(OH)O. M. J. Buerger. *Zeits. f. Krist.* 95. *pp.* 163–174, *Nov.*, 1936. *In English.*—Manganite is found to be monoclinic, not orthorhombic, as stated in reference books. Twin lamellæ were detected parallel to (100), the supposed symmetry plane, showing up well on the crystal terminations. Thin cleavage flakes show inclined extinction of alternate systems of bands seen by transmitted polarised light. If a manganite cleavage splinter, bounded by the excellent (010) and perfect (110) cleavages, is set up on a two-circle goniometer with the cleavage zone taken as equator, then the natural (001) surface may have a co-ordinate of almost 4° (instead of 0° if the crystal is orthorhombic). From an X-ray examination by the equi-inclination Weissenberg method with FeK–radiation, an arsenopyrite-like structure, which is a superstructure based upon the marcasite type, is proposed. Unit cell: $a=8·86$, $b=5·24$, $c=5·70$ Å, $\beta=90°$, space group $B2_1/d$. The hydrogen bonding and the mild layering of the structure into (010) sheets accounts perfectly for the outstanding (010) cleavage and the (010) translation-gliding plane. W. H. Ge.

5363. Structure of $5CaO.3Al_2O_3$. W. Büssem and A. Eitel. *Zeits. f. Krist.* 95. *pp.* 175–188, *Nov.*, 1936.—Single crystals were obtained from a melt. They are cubic with $a=11·95$ Å., density$=2·69$, space group$=T_d^6$. It is found that better agreement of the observed intensities of X-ray reflection with the calculated ones can be obtained if one assumes the composition to be $12CaO.\ 7Al_2O_3$ instead of $5CaO.\ 3Al_2O_3$ and there are then 2 mol. of the former composition per unit cell. The crystals have a garnet-like structure with AlO_4 groups replacing the AlO_6 and SiO_4 groups of garnet. J. I.

5364. Fibrous Brucite. J. Garrido. *Zeits. f. Krist.* 95. *pp.* 189–194, *Nov.*, 1936. *In French.*—Samples of fibrous brucite are shown, by means of X-ray powder photographs, to have the same crystal structure as ordinary brucite. With this variety, however, the rings on the photographs show evidence of orientation. It is concluded that the small crystallites of which the fibres are composed are arranged with their *c* axes perpendicular to the fibre axis. Some of the crystallites have their *a* axes parallel to the fibre axis, whilst others have the direction $[11\bar{2}0]$ parallel to this axis. The unit cell has the following dimensions, $a = 3 \cdot 125$ Å., $c = 4 \cdot 752$ Å. The fibres when heated at 500° C. lose water and cubic MgO is formed. The crystallites of MgO arrange themselves so that the directions [111] and [110] of MgO correspond to the directions [0001] and $[10\bar{1}0]$ respectively of the original brucite. J. I.

5365. Density and Structure of Zircon. K. Chudoba and M. v. Stackelberg. *Zeits. f. Krist.* 95. *pp.* 230–246, *Nov.*, 1936.—The *a* form is uni-axial and weakly birefringent, *b* is uniaxial and strongly birefringent, *c* is bi-axial. At 1450° *c*-zircon (density 4·32) and *a*-zircon (density 4·15) are changed to *b*-zircon. The relation of the lattice constants is discussed. F. I. G. R.

5366. Structure of Kaolinite, $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$, and Composition of Anauxite. S. B. Hendricks. *Zeits. f. Krist.* 95. *pp.* 247–252, *Nov.*, 1936. *In English.*—By means of an X-ray and electron diffraction study of orientated crystal aggregates of kaolinite and anauxite the author confirms the structure proposed by Gruner. It is concluded that the increase in the $SiO_2 : R_2O_3$ ratio in anauxite above that required for $(Al_2O_3 \cdot 2SiO_2)(2H_2O)$ is the result of withdrawing Al ions and (OH) groups rather than the isomorphous replacement of Al by Si in the $Al_2\,Si_2\,O_5(OH)_{4n}$ layers. J. I.

5367. Structure of Sodium Carbonate Monohydrate, $Na_2CO_3 \cdot H_2O$. J. P. Harper. *Zeits. f. Krist.* 95. *pp.* 266–273, *Nov.*, 1936. *In English.*—Orthorhombic crystals were obtained from a water solution at 73° C. X-ray measurements give the following data: $a = 10 \cdot 721$ Å, $b = 6 \cdot 440$ Å, $c = 5 \cdot 243$ Å, density (observed) = 2·25, density (calculated) = 2·2578, 4 mol. per unit cell, space group = $2e - 5$. An examination of the intensities of reflection shows that each sodium atom is surrounded by 6 O atoms. The average Na–O distance is 2·46 Å, and the average $Na - H_2O$ distance is 2·56 Å. Each of the 16 O atoms in the cell touches 3 Na atoms. J. I.

5368. Crystallisation of Silica in $NaPO_3$. G. Peyronel. *Zeits. f. Krist.* 95. *pp.* 274–281, *Nov.*, 1936. *In Italian.*—The author has investigated by means of chemical, microscopical and X-ray methods, the SiO_2 skeleton in the phosphorous-salt pearls obtained by heating a silica gel with fused $NaPO_3$. It is found that the SiO_2 at the formation temperature (700°–800° C.) is in the form of β-crystobalite; this changes to the α-form on cooling. The process of crystobalite formation has been studied as well as the action of free P_2O_5 in the melt. J. I.

5369. Structure of Tripelnitrite. M. van Driel and H. J. Verweel. *Zeits. f. Krist.* 95. *pp.* 308–314, *Nov.*, 1936.—The general chemical formula is $A_2BM(NO_2)_6$, with $2A : \frac{1}{4}\frac{1}{4}\frac{1}{4}\ \frac{3}{4}\frac{3}{4}\frac{3}{4}$; $B : \frac{1}{2}\frac{1}{2}\frac{1}{2}$; $M : 0\,0\,0$; $6N : xoo, \bar{x}oo, oxo, o\bar{x}o, oox, oo\bar{x}$; $12O : oyz, o\bar{y}\bar{z}, zoy, \bar{z}o\bar{y}, yzo, \bar{y}\bar{z}o, oy\bar{z}, o\bar{y}z, \bar{z}oy, zo\bar{y}, y\bar{z}o, \bar{y}zo$. F. I. G. R.

5370. Crystallographic and Optical Data for Cs_2CuCl_4. D. P. Mellor and Florrie M. Quodling. *Zeits. f. Krist.* 95. *p.* 315, *Nov.*, 1936. *In English.*—This substance crystallises in brilliant yellow prisms, with normal orthorhombic symmetry, axial ratio a : b : c = 0·7855 : 1 : 6141, optically positive, optic axial plane 100, 2V(calc.) = 83° 46′. Faint pleochroism. F. I. G. R.

5371. Lattice-Blocks in Mosaic Crystals. J. Leonhardt and R. Tiemeyer. *Zeits. f. Physik,* 102. 11–12. *pp.* 781–790, 1936.—X-ray investigations show that the lattice-blocks in $NaNO_3$ crystals are arranged so that there is distortion around the [100] direction. The development of the mosaic character of crystals is discussed. J. I.

5372. Etching of Copper by Oxygen. C. F. Elam. *Faraday Soc., Trans.* 32. *pp.* 1604–1613, *Nov.*, 1936.—It is shown that an etching effect obtained on heating Cu *in vacuo,* is due to the presence of Cu_2O. The effect can be produced artificially by oxidising the surface and it is suggested that the etch is due to attack by O_2 along crystal planes similar to the action of any etching agent. The planes most readily attacked appear to be [100] and [110] planes of the Cu crystal. The relation between the orientation of the Cu crystal and the Cu_2O formed when Cu is oxidised in the presence of a small quantity of air at low pressures was investigated. The first layer to be formed consists of small crystals arranged approximately in the same way as the Cu. Subsequent layers take the form of a fibre structure in which a [100] direction agrees closely with the first layer and with a [110] of the Cu crystal. AUTHOR.

5373. Optical Crystallographic Data for Salts of Cinchona Alkaloids. Mary L. Shaner and M. L. Willard. *Am. Chem. Soc., J.* 58. *pp.* 1977–1978, *Oct.*, 1936.—The crystallographic data for four cinchona alkaloids—quinine, quinidine, cinchonine and cinchonidine—are worked out. The fluorescent properties in u.v. light are also determined. AUTHORS.

5374. Structure of Condensed Ring Compounds. Part V. Three Isomeric Dibenzcarbazoles. J. Iball. *Zeits. f. Krist.* 95. *pp.* 282–295, *Nov.*, 1936. *In English.*—The crystal structure of three dibenzcarbazoles has been investigated by means of X-rays. The crystal data are given in the following table :—

	3 : 4 : 5 : 6-Dibenzcarbazole	1 : 2 : 7 : 8-Dibenzcarbazole		1 : 2 : 5 : 6-Dibenzcarbazole
	orthorhombic	monoclinic	orthorhombic	orthorhombic
a (Å)	14·07	14·63	10·27	31·10
b (Å)	6·10	7·64	10·26	9·65
c (Å)	15·36	12·08	50·5	26·61
β	90°	96·0°	90°	90°
Probable space group	$D_2^5 - A2_122$	$C_{2h}^2 - P2_1/m$	$D_2^7 - F222$	$D_{2h}^{15} - Pbca$
Mol. per unit cell	4	4	16	24
Measured density (20° C.)	1·336	1·302	1·328	1·323
Calculated density	1·338	1·312	1·327	1·322

Suggestions are put forward for the molecular arrangement on the basis of the above data, the optic orientations and the intensities of reflection. [For Part IV see Abstract 3970 (1936).] AUTHOR.

5375. Organic Crystals with Chain Molecules. A. Müller. *Helv. Phys. Acta*, 9. 7. *pp.* 626–634, 1936. *In German.*—The connection between the structure and energy of a group of organic bodies containing homopolar chain molecules is discussed. Changes of the lattice and the rotation of the chain molecules near the melting point are described.
J. E. R. C.

5376. X-Ray Diffraction Studies of Built-Up Films. G. L. Clark and P. W. Leppla. *Am. Chem. Soc., J.* 58. *pp.* 2199–2201, *Nov.*, 1936.—The structures of Blodgett's composite films of stearic acid and stearates are investigated by X-ray diffraction methods. The structure and hence the thickness are found to be that of the constituent present in greater proportion. The *d* spacings agree closely with those of the crystalline material. Intensity measurements are made from successively increasing numbers of planes and the degree of perfection inferred therefrom. Laue's particle size equation is tested by the use of films of known thickness.
AUTHORS.

5377. X-Ray Study of Substituted Biphenyls. Lucy W. Pickett. *Am. Chem. Soc., J.* 58. *pp.* 2299–2303, *Nov.*, 1936.—Additional experimental data concerning the crystal structures of five biphenyl derivatives are presented. The unit cell of quaterphenyl has the dimensions $a = 8{\cdot}05$, $b = 5{\cdot}55$, $c = 17{\cdot}81$ Å, $\beta =$ approximately $95{\cdot}8°$ and contains two centro-symmetrical molecules. Trial and error analyses together with a one-dimensional Fourier projection indicate that the molecules are orientated at an angle of $17{\cdot}3°$ to the normal to the (001) plane in the acute angle β and that the C-C distance between benzene rings is $1{\cdot}48$ Å.
AUTHOR.

5378. Light Scattering in Liquid-Crystalline p-Azoxyanisol. W. de Braaf and L. S. Ornstein. *Kolloid Beihefte*, 44. 8–12. *pp.* 427–475, 1936.—A detailed review of the work on this substance under the following heads: Transmission as a function of temperature and magnetic field, observations in polarised light, scattering in strong magnetic fields, theoretical considerations.
F. I. G. R.

5379. Crystallisation of Undercooled Liquids. W. T. Richards, E. C. Kirkpatrick and C. E. Hutz. *Am. Chem. Soc., J.* 58. *pp.* 2243–2248, *Nov.*, 1936.—It is shown that salol, benzophenone and benzene crystallise spontaneously by a heterogeneous mechanism even in the absence of overheatable nuclei. The tendency to form overheatable nuclei and the spontaneous tendency to crystallise, appear to be entirely unrelated, since the former may be destroyed by heating without affecting the latter. A tentative mechanism is suggested whereby one type of absorptive force might result in both forms of activity. The study is related to previous investigations on the subject. [See Abstract 2271 (1932).]
AUTHORS.

5380. Nature of U-Centres in Alkali Halide Crystals. R. Hilsch and R. W. Pohl. *Göttingen Nachrichten, Fachgruppe II.* 2. 12. *pp.* 139–143, 1936.—U-centres are alkali hydride molecules, formed by the action of H, reacting with excess alkali metal.
F. I. G. R.

5381. Anisotropy of "Polish-Hardness" in Barytes. H. Tertsch. *Zeits. f. Krist.* 95. *pp.* 296–307, *Nov.*, 1936.—Investigation by usual method of the prismatic cleavage face, and the basal plane. Owing to its brittleness, it wears out much more readily than calcite or dolomite.
F. I. G. R.

5382. Electrical Anisotropy of Single Crystals of W at Low Temperatures in Strong Magnetic Fields. E. Justi and H. Scheffers. *Phys. Zeits.* 37. *pp.* 700–708, *Oct.* 15, 1936. *From the Reichsanstalt.*—Crystals of very pure W lose 99·9 % of their electrical resistance at 0° C. on being cooled to the temperature of liquid He but on applying a transverse magnetic field of about 20,000 G. the resistance increases to its value at 0° C. The resistance is not isotropic in a magnetic field above the temperature of liquid N_2, as would be expected on the conception of an isotropic electron gas, but its value depends appreciably on the angle that the transverse field makes with the crystal axis. If the field is at right angles to certain crystal planes, a minimum occurs in the rate of increase of resistance and is lower the smaller the indices of the plane—the lowest value is for the [100] planes. Body-centred W shows half as many maxima and minima as face-centred Au [see Abstract 3816 (1936)]. At temperatures in the region of liquid H_2 and He, the resistance increases approximately with the square of the field strength without any indication of saturation (predicted theoretically). The rate of increase of resistance in the field increases slowly at first as the temperature is lowered, then more rapidly but finally, at the temperature of liquid He, it is independent of temperature. Impurities have a profound effect on the measured values. The results are explicable in terms of the valency hypothesis of J. Stark. H. J. H. S.

5383. Magnetic Anisotropy and Structure of $CuSO_4 \cdot 5H_2O$. Part I. K. S. Krishnan and A. Mookherji. *Phys. Rev.* 50. *pp.* 860–863, *Nov.* 1, 1936.—The magnetic anisotropy of the triclinic crystal $CuSO_4 \cdot 5H_2O$ has been measured. The crystal is found to be nearly uniaxial magnetically, *i.e.*, has an axis of approximate magnetic symmetry, the susceptibility along the axis being less than that along perpendicular directions by about 300×10^{-6} c.g.s. e.m.u. per gm. mol. at 26° C. The above axis is inclined at 156°, 65°, and 52° respectively to the "*a*," "*b*," and "*c*" axes of the crystal. These results are discussed in relation to the known arrangement of the water molecules and O atoms round the Cu^{++} ions and the resulting crystalline electric fields acting on the latter. AUTHORS.

5384. Production of X-Ray Layer-Line Diffraction Patterns by Means of Convergent and Oscillation Photographs. O. Kratky and G. Krebs. *Zeits. f. Krist.* 95. *pp.* 253–265, *Nov.*, 1936.—The positions of the layer-lines of a complete rotation photograph are obtained by oscillating the crystal through a small angle or by using a beam of X-rays which converges through a small angle, 4°–10°. In the latter case the crystal is stationary during the exposure thus reducing the time of exposure. The method is particularly useful for small and ill-formed crystals which are difficult to set accurately. In the photographs by this method a mis-setting of the crystal produces only a slight curving of the layer-lines,. Equations are given from which one can calculate the amount of mis-setting or correct for it in the calculation of the primitive translation of the crystal lattice. J. I.

5385. X-Ray Investigation of the Glassy State. N. Valenkov and E. Poray-Koshitz. *Zeits. f. Krist.* 95. *pp.* 195–229, *Nov.*, 1936. *In English.*—There are two hypotheses to consider (1) Warren's, which postulates continuous non-crystalline atomic networks, and (2) the crystallite theory. Extensive X-ray observations show that the latter view is correct, and it is used to explain Ostwald's rule, with the help of the concept of cybotactic groups. F. I. G. R.

See also Abstracts 5351, 5353, 5398, 5503, 5523, 5682, 5683, 5706, 5707, 5716.

DENSITY.

5386. Density of Saturated Vapours. M. F. Soonawala. *Indian Journ. Phys.* 10. *pp.* 353–364, *Sept.*, 1936.—The surface of a liquid is treated as a potential barrier, and the probability of transition across it of a molecule is obtained on the wave-mechanical theory. On comparison with the known behaviour of the density of saturated vapours at different temperatures, it is shown that a molecule in a liquid possesses potential energy in addition to the usual kinetic energy. This potential energy per molecule is calculated for some liquids. AUTHOR.

5387. Protium-Deuterium Ratio in Water. N. F. Hall and T. O. Jones. *Am. Chem. Soc., J.* 58. *pp.* 1915–1919, *Oct.*, 1936.—From surface water of Lake Mendota, nearly D_2-free water was prepared (1) by repeated electrolysis and recombination of electrolytic gases, the deficiency in O^{18} being restored by CO_2 equilibration against the original water, and (2) by burning the electrolytic H_2 in air, the excess of O^{18} being removed as above. In each case the density loss is $16 \cdot 5\gamma$. Measurements of refractive index indicate that the entire decrease is due to D_2. The calculated H/D ratio is 6400 ± 200. Discrepancies in available data are probably due to inadequate correction for alteration in the O isotope ratio. N. M. B.

5388. Influence of Combustion Conditions on the Density of Water Formed from Commercial Hydrogen and Oxygen. W. H. Hall and H. L. Johnston. *Am. Chem. Soc., J.* 58. *pp.* 1920–1922, *Oct.*, 1936.—Density comparisons of water produced by flame combustion of commercial H_2 and O_2 show that the proportion in which the gases are brought together for reaction results in no significant change in the isotopic composition of either H_2 or O_2, but for combination on a Pt catalyst the density of the resulting water may be low if O_2 is in excess and high if H_2 is in excess, the probable explanation of the low density being lower reaction velocities of O_2 molecules containing O^{18}, and, of the high density, an incomplete exchange reaction between steam and the excess H_2. N. M. B.

5389. Dependence of Apparent Molar Volume upon Concentration for Strong Electrolytes. A. Kruis. *Zeits. f. phys. Chem.* 34. *Abt. B.* 1–2. *pp.* 1–12, 1936.—Apparent molar volumes of some salts in solution are determined for use in connection with optical investigations [see Abstract 5543 (1936)]. The densities of aqueous solutions of NaCl and $SrCl_2$ from 1 to $0 \cdot 01$ *N.* are measured at 25° C. by a float method. For solutions of KCl, $SrCl_2$ and NH_4NO_3 the apparent molar volumes are determined from high concentrations down to about $0 \cdot 2$ *N.* by means of a dilatometer which gives the volume contraction on dilution. The experimental error corresponds to an error in density of a few units in the sixth decimal place. The dependence of apparent molar volume upon square root of volume concentration is represented graphically and compared with the requirements of the theory of Redlich and Rosenfeld. L. A. W.

See also Abstracts 5518, 5547, 5668.

DIFFUSION AND OSMOSIS.

5390. Diffusion of Solids. J. Cichocki. *J. de Physique et de Radium.* 7. *pp.* 420–426, *Oct.*, 1936.—For the diffusion of two metals in contact, it is assumed that the plane of separation disappears, and that in its place there forms a layer of alloy of both metals. Diffusion proceeds as if the faces of this alloy layer advance into each of the two metals with velocities proportional to the diffusion constants of one metal into the other. The ratio of the two diffusion constants of Au into Pb and of Pb into Au is of the order of 10^{26} at 285° C. By means of the calculus of probabilities an equation is obtained for these mutual diffusion constants of two metals, i.e. of autodiffusion. Tables of results are included for the metals: Na, Mg, Ag, Cd, In, Snβ, Au, Hg, Tlβ, Pb, Bi. From similar considerations a formula is derived giving the concentration or the degree of faults in wire systems. H. H. Ho.

See also Abstract 5419.

ELASTICITY AND PLASTICITY.

5391. Integrals in Dynamical Problem of Vibrating Beams. E. Frola. *Accad. Lincei, Atti.* 23. *pp.* 739–743, *May* 17, 1936.—The problem of the vibrations of a loaded beam is treated by means of an integral equation, which is solved in the case of a beam starting from rest. The motion of the beam is obtained by transforming the load function by means of an operator, which is a Fredholm operator with respect to the spatial axis and a Volterra operator with respect to the time. The nucleus of this operator is interpreted physically as the vibration caused by an instantaneous blow of unit impulse at any point of the beam, which is initially at rest. A. J. McC.

5392. Elastic Instability. E. Frola. *Accad. Lincei, Atti,* 23. *pp.* 744–752, *May* 17, 1936.—Some problems of elastic instability are treated by means of the equation $\{C(x)\ y'(x)\}' = -\lambda\ M\ (x)\ \sin y(x)$; $y\ (0)=0$, $y(1)=0$. For example, if $C(x)$ and $M(x)$ are constants, the equation becomes that of the finite oscillations of a pendulum. The author investigates the analytical character of the solution of this equation, which can also be regarded as a non-linear integral equation. A. J. McC.

5393. Plane Strain in an Infinite Plate with an Elliptic Hole. S. Ghosh. *Calcutta Math. Soc., Bull.* 28. *pp.* 21–47, *March,* 1936. *In English.*—The analysis given by the author in a previous paper (*Am. Math. Soc., Trans.* 32. 1. 47–60, 1930) for the solution of problems of elasticity with the use of elliptic coordinates is extended and applied to the problem of finding the stress function for plane strain in an infinite plate with an elliptic hole, with prescribed surface tractions at the elliptic boundary, these prescribed surface tractions being in equilibrium. The analysis proceeds by the use of Fourier series in the eccentric angle. S. G.

5394. Buckling of a Rectangular Plate with Four Clamped Edges. K. Sezawa and W. Watanabe. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 143. *pp.* 409–418, *Aug.*, 1936. *In English.*—The problem of determining mathematically the buckling load for a rectangular plate with four clamped edges has been previously considered by the first of the authors [see Abstract 2553 (1931)] and by other writers to whom full references are given. A new discussion is here given, starting from type solutions which give zero slope at the boundaries. Fourier series are used in the same way as by Taylor [see Abstract 2733 (1933)], and the numerical solution completed by making the displacement approximately zero at the boundaries (with a finite number of terms in place of an infinite series). Results are given for a square plate, for which there is agreement with Taylor's results, and for a long rectangular plate under edge thrust in its lengthwise direction for which there is fair agreement with the results of Faxén (*Zeits. f. angew. Math. u. Mechanik*, 15. 268–277, 1935). S. G.

5395. Bending of Triangular Plates. R. Girtler. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 1–2. *pp*. 61–72, 1936.—An expression is found, in the form of a double series (as in the Navier solution for a rectangular plate) for the displacement of a triangular plate of angles 30°, 60°, 90° either under a uniform load or under a load concentrated at one point. The equation solved is that of the usual Poisson-Kirchhoff approximate theory (displacement small compared with the thickness of the plate, etc.), with Navier's boundary conditions $w=0$, $\nabla^2 w=0$. Some numerical results are given to illustrate the convergence of the series, and the Rayleigh-Ritz method is applied with the displacement assumed a multiple of the first term of the series. S. G.

5396. Stability of a Thin Plate under Edge Thrust, Buckling Being Resisted by a Small Force Varying as the Displacement. B. Sen. *Calcutta Math. Soc., Bull.* 27. *pp*. 157–164, *Sept.–Dec.*, 1935.—Special solutions of the equation of equilibrium for a slightly deflected position of the plate are found, and the conditions of stability inferred, for the following cases: circular plate with clamped edge; rectangular plate with supported edges; rectangular plate with two supported edges subject to thrust, and two free edges not subject to thrust. S. G.

5397. Stability of Elastic Equilibrium of Solids in Constraint. C. Tagliacozzo. *Ricerche di Ingegneria*, 4. *pp*. 95–98, *Sept.–Oct.*, 1936.—The general problem of the critical equilibria of solids in elastic constraint is considered with the object of designating the most fitting methods for its study. A case of practical importance is that of the instability of arches arising from an increase of temperature. The simplest case possible is dealt with, and it is considered that the problem of critical equilibrium in less simple systems of solids in constraint presents no greater difficulty than in ordinary cases of external forces explicitly given. J. J. S.

5398. Mechanics of Solid Bodies. Part I. T. Pöschl. *Die Physik*, 4. 4. *pp*. 131–144, 1936.—A summary of literature on the mechanical properties and behaviour of solids is given under the following headings: I. The elastic region—(*a*) elastic constants, (*b*) elasticity of crystals, (*c*) measurement of strain, (*d*) fundamental equations of the theory of elasticity, (*e*) pressure and tension on bodies of different shape, (*f*) bending of rods and plates, (*g*) bending of discs, tubes and sheets, (*h*) torsion and (*i*) elastic stability and fracture. II. Beyond the elastic region—(*a*) elastic limits, (*b*) yield points, (*c*) flow, (*d*) viscosity, (*e*) plasticity and resistance of crystals, (*f*) improvement by cold working, (*g*) fracture, (*h*) endurance characteristics, (*i*) fatigue resistance, (*j*) elastic secondary effects, (*k*) corrosion, (*l*) rolling and drawing, and (*m*) welded seams. H. J. H. S.

5399. Volume of Stretched Rubber. W. L. Holt and A. T. MacPherson. *Bureau of Standards, J. of Research*, 17. *pp*. 657–678, *Nov.*, 1936.—The change of volume on stretching was studied for four rubber compounds; two were pure gum, and one each contained 10 % by volume of carbon black and whiting, respectively. Samples were made in the form of narrow moulded rings. Measurements of the change with time up to about 20 min. were made with a water-filled dilatometer; for longer periods a mercury-filled dilatometer was used. The whiting compound increased in volume on stretching, presumably on account of the formation of vacuoles around the coarse particles of filler. With the other compounds the volume remained constant up to an elongation of 200 or 300 % above which it decreased by an amount which was greater the higher the elongation, the lower the temperature, and the longer the time the rubber was kept stretched. The decrease was an approximately linear function of the logarithm of the time from a few minutes after stretching, to about 4 weeks, the duration of the experiment. The volume thermal expansivity of the stretched rubber was greater than that of the unstretched. Increased vulcanisation of a given compound, in general, decreased the volume change on stretching. The results indicate that, in the absence of coarse fillers, Poisson's ratio for rubber is 0·5 or greater, the numerical value depending upon the composition, the temperature, the time after stretching, and other factors. AUTHORS.

5400. Frequency of Transverse Vibration of a Loaded Fixed-Free Bar. R. M. Davies. *Phil. Mag.* 22. *pp.* 892–898, *Nov.*, 1936. *Supplement.*—If l is the length of the bar and m a frequency parameter given in terms of the elasticity and so forth of the loaded bar, the object of the theory is to obtain a value for z ($= ml$). The differential equation of motion of the bar is solved to obtain a transcendental equation in z. The trigonometrical and hyperbolic functions are expanded and higher terms neglected; thus giving an approximate value of z. Results are compared with true values of z for particular cases (for example for the unloaded bar) and the accuracy is shown to be better than that obtained by Rayleigh's and Morrow's approximate methods, moreover, the higher terms add very little to this accuracy; thus a simple equation connecting z and c, the ratio of the mass of the load to that of the bar, is found. H. M. B.

5401. Oscillations of Vibrating Circular Arcs Perpendicular to the Circular Plane. K. Federhofer. *Akad. Wiss. Wien. Ber.* 145. 2*a*. 1–2. *pp.* 29–50, 1936.—A differential equation of the oscillations which are produced by flexure and torsion in the plane of a beam bent into a circular arc is obtained and compared with that of Walking for flexural vibrations. For symmetrical oscillations the results agree with those of Brown [See Abstract 3514 (1934)], but the investigation is extended to fundamental counter-oscillations. Numerical values are given to show that for bars of various cross-sections, the stiffness thus produced has a great effect upon the oscillation frequency, but changes the positions of the nodes and the amplitude hardly at all. The most interesting case of I cross-section is to be more fully investigated. H. M. B.

5402. Conditions on the Wave-Front and Harmonic Electromagnetic Waves. G. A. Maggi. *Accad. Lincei, Atti,* 23. *pp.* 9–15, *Jan.* 5, 1936.—The kinematical and dynamical conditions on the wave-front are considered in the case of general waves, solutions of d'Alembert's wave equation, and in the case of electromagnetic waves, particularly with regard to harmonic solutions of Maxwell's equations. In the first case, given a family of solutions, all the solutions of the family satisfy the imposed conditions only if the waves are plane, but a particular solution (which is not a plane wave) may satisfy the conditions considered. In the second case, given a family of harmonic solutions, all the solutions of the family satisfy the conditions only if the waves are plane, but a particular solution may satisfy the conditions either if the waves are plane or if they are spherical—in this last case the solution is not definite in the whole of space outside the base sphere. A. J. McC.

See also Abstracts 5422, 5517.

GRAVITATION.

5403. Gradient and Curvature of a Segment of an Infinite Horizontal Cylinder. K. Mader. *Gerlands Beitr. z. Geophys.* 48. 4. *pp.* 417–427, 1936.—The gravitational effect of a circular cylinder of given density lying horizontally is worked out mathematically. W. A. R.

***5404. Gravity Measurements in Southern Sweden with Astatic Quartz Pendulum. G. Ising and T. Eeg-Olofsson.** *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A. No.* 13. [22 *pp.*], 1936. *In German.*—Several small alterations (six of which proved to be improvements and two the reverse) in the astatic pendulum are described; and the use of the revised instrument, which with the 4 kg. ice required in its use, weighs in all about 30 kg., and enables gravity to be determined at the rate of about 100 stations a month, is illustrated by a series of determinations in the extreme south of Sweden and (for checking purposes) at Copenhagen. The results show close agreement with ordinary pendulum observations, the slight differences and possible sources of error are discussed, as also the variation in gravity with geological formation. C. A. S.

5405. Gravity Anomalies and Disturbance of Connecting Layers in the Earth's Crust. E. A. Ansel. *Beitr. z. angew. Geophys.* 6. 2. *pp.* 141–167, 1936. *In German.*—Gravity anomalies are considered due to a density distribution different from the normal caused by mechanical disturbances altering the distribution of the layers or by thermochemical dissociation within the layers. The field of gravity anomalies belonging to definite ridges or troughs at various depths is obtained and the field is most simply represented by a prism with its base at sea level. Jeffreys' conception of the three layers of the earth's crust is employed. The results obtained are shown in diagrams. The Himalayas with a positive anomaly and the Ganges plain are considered and good agreement is obtained between theory and observation for Central India. R. S. R.

See also Abstracts 5433, 5474, 5475, 5478.

HYDRODYNAMICS AND AERODYNAMICS.

5406. Zavorra Effects in Space. U. Cisotti and A. Masotti. *Accad. Lincei, Atti,* 23. *pp.* 3–8, *Jan.* 5, 1936.—The motion of an infinite liquid past a fixed body is considered in the three cases (1) when there is a definite stream of liquid at infinity, (2) when there is a source at the surface of the body and the liquid is at rest at infinity, and (3) when there is both a stream of liquid and a source on the body. The Zavorra effect is the excess of the dynamical actions on the body in case (3) over the sum of those in cases (1) and (2). Simple expressions are here found for the Zavorra effect on any rigid body and applied to the particular case of a sphere. In this last case, the force R and the couple M of the Zavorra effect is $R = \rho q\,(-V_1 + \frac{1}{2} V_2)$, $M = 0$, where q is the strength of the source and V_1, V_2 are the two components of the velocity of the stream at infinity, the first parallel and the second perpendicular to the diameter through the source. A. J. McC.

5407. Second Form of Equations of Turbulence for the Hypothesis of a Direction of Transport. G. D. Mattioli. *Accad. Lincei, Atti*, 23. *pp*. 49–54, *Jan*. 5, 1936.—The author has indicated the form to be assumed by the equations of turbulence in the isotropic case in which the turbulent transport of mass has constant intensity in all directions at every point [see Abstract 445 (1936)]. A second form of these equations of turbulence is suggested for the case in which there is a privileged direction of transport at each point. This privileged direction is taken to be orthogonal at each point to the mean velocity vector and the mean vortex vector. A. J. McC.

5408. Energy Equation of Turbulence and Conditions of Integration. G. D. Mattioli. *Accad. Lincei, Atti*, 23. *pp*. 55–60, *Jan*. 5, 1936.—The conditions to be satisfied at the boundary in a turbulent motion can be investigated by means of the energy equation of the turbulent motion. This equation expresses the rate of change of energy in terms of (1) the work done by the external forces and pressures, (2) a function of dissipation in the interior of the mass, and (3) a surface integral. This last integral can be interpreted physically partly as a loss of momentum, partly as a production of vorticity at the boundary and partly as a flux of gyrostatic energy. This involves the assumption that the velocity at the boundary of the turbulent region may be different from zero. The boundary conditions which determine uniquely the integral in the whole field of motion comprise, in addition to the assignment of the velocity, that of the first and second derivatives of the velocity along the direction of transport. While it seems possible to assign the first derivative in all cases, it is not possible to assign the second derivative at points of the boundary independently of the form of the field. A. J. McC.

5409. Velocity and Temperature Distributions behind a Row of Parallel Rods (Turbulent Flow). R. G. Olsson. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp*. 257–274, *Oct*., 1936.—The velocity and temperature distributions behind a row of parallel equally-spaced, similar, heated rods in a plane at right angles to the stream were investigated both theoretically and experimentally. U denotes the stream velocity, U–u the velocity in the wake, Θ the temperature difference in the wake, and first approximations to u and Θ were found at a large distance downstream. The motion is two-dimensional; the axis of x is in the direction of the stream, through the centre of a section of one of the rods. If χ is the so-called kinematic "Austauschgroesse," for which Prandtl writes $\chi = l\left|\frac{\partial u}{\partial y}\right|$, then Prandtl has also suggested that it would be more accurate to take in this formula an average value of $\left|\frac{\partial u}{\partial y}\right|$ over a small neighbourhood, or, approximately, $\chi = l^2\left\{\left(\frac{\partial u}{\partial y}\right)^2 + l'^2\left(\frac{\partial^2 u}{\partial y^2}\right)^2\right\}^{\frac{1}{2}}$. This latter suggestion is here used for the first time in theoretical work. l is taken as a constant, and two cases are worked out: $l' = \lambda/2\pi$, where λ is the distance between two neighbouring rods, and $l' = 0$. In the first case the velocity distributions are the same on the momentum-transfer or the vorticity-transfer theory, $u = \frac{U\lambda^3}{8\pi^3 l^2 x}\cos\frac{2\pi y}{\lambda}$, and χ is constant across the wake. In the second case, with l denoted by l_0, on the momentum-transfer theory $u = \frac{U}{2(4\cdot 52)^3}\frac{\lambda^3}{l_0^2 x}$ F(η), where $\eta = 4\cdot 52\ y/\lambda$, and $\eta = \left(\frac{2}{3}\right)^{\frac{1}{2}}\int_y^1 \frac{dF}{(1-F^2)^{1/3}}$; ($y = \frac{1}{2}\lambda$ when F $= 0$). The maximum value of u must be the same, so l_0 must equal $1\cdot 16\,l$. (On the vorticity-transfer theory in the second case the same velocity distribution multiplied by 2 would be obtained). With $l' = \lambda/2\pi$ the temperature distribution and the velocity distribution are the same: with $l' = 0$ they are the same on the momentum-transfer theory, and the author asserts that on the vorticity-transfer theory a temperature distribution cannot be obtained, since the calculations would make the gradient across the wake infinite behind a rod. If only a single rod is heated, then with $l' = \lambda/2\pi$, the temperature distribution is proportional to $(\log x/a)^{-\frac{1}{2}} \exp\left(-\frac{\pi^2 y^2}{\lambda^2 \log x/a}\right)$ where a is a constant. At a sufficient distance downstream the law of decay of u ($\propto x^{-1}$) was verified, and the velocity distribution across the wake lay between the two theoretical curves. It was found that l ($= 1\cdot 16\,l_0$) $= 0\cdot 120\lambda$, but the scatter was too large to determine a value of l'. Further upstream the velocity distribution was too flat, and still further upstream, near the rods, was too pointed. With all the rods heated, the heat interchange, with consequent tendency to uniformisation of temperature, proceeded too rapidly for an experimental confirmation to be obtained; for a single-heated rod the temperature distribution across a section of the wake was in satisfactory agreement with theory, except near the edges of the heat wake. Experimental results (small-scale graphs) are also given for the temperature distribution across a section of the wake behind a single-heated rod alone in the stream, and behind a heated body of revolution. S. G.

5410. Hydrostatic Pressure Variation. **G. Arrighi.** *Accad. Lincei, Atti*, 23. *pp.* 929–932, *June* 5, 1936.—Suppose a body, immersed in a heavy liquid whose density varies with the depth, is given a definite displacement. The paper investigates the change of pressure with time. W. A. R.

5411. Stability of a Double Row of Vortices with Unequal Strengths in a Channel of Finite Breadth. **I. Imai.** *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 436–459, *Sept.*, 1936.—If the strengths of the vortices in both rows of a Kármán vortex street in a channel are the same, then the vortex street can maintain its position only if the axis of the street coincides with the axis of the channel. The stability of this arrangement has been studied by Rosenhead, and also, for a very restricted type of disturbance, by Tomotika. It has recently been pointed out by P. Schwarz [see Abstract 1994 (1936)], that if the strengths in the two rows are different, then the axes of the street and the channel will not coincide for a permanent configuration. The stability of this more general arrangement is considered in this paper, but by the method of Tomotika, with a very restricted type of disturbance. Numerical results are given for various particular cases. The result for equal strengths in both rows in an unlimited fluid, found as a special limiting case, appears to be in disagreement with Kármán's original result. S. G.

5412. Wave-Making Resistance of a Ship Moving in a Canal. L. N. Srettensky. *Phil. Mag.* 22. *pp.* 1005–1013, *Nov.*, 1936. *Supplement.*—By the method of images the velocity potential is found for a "Michell" ship moving in the plane of symmetry with velocity c along a canal of infinite depth and of breadth b, and the following formula deduced for the wave resistance:

$$\mathrm{R} = \frac{16\pi^2 \rho g}{b c^2}\left\{ \mathrm{I}_0^2 + \mathrm{J}_0^2 + 2\sum_{k=1}^{\infty} (\mathrm{I}_k^2 + \mathrm{J}_k^2) \frac{\cosh^2\tau_k}{\cosh 2\tau_k} \right\},$$

$$\text{where } \mathrm{I}_k = \iint_{\mathrm{S}} \mathrm{F}(x,z) \exp\left(\frac{g}{c^2}\cosh^2\tau_k z\right) \cos\left(\frac{gx}{c^2}\cosh\tau_k\right) dxdz,$$

$$\mathrm{J}_k = \iint_{\mathrm{S}} \mathrm{F}(x,z) \exp\left(\frac{g}{c^2}\cosh^2\tau_k z\right) \sin\left(\frac{gx}{c^2}\cosh\tau_k\right) dxdz,$$

($k = 0, 1, 2, 3, \ldots$), τ_k being the root of the equation, $(gb/4c^2)\sinh 2\tau = k\pi$, and F (x,z) being the source density over the plan area S in the usual way. When $b \to \infty$, the formula reduces to the Michell formula. S. G.

5413. Instability of a Cylindrical Column of a Perfect Liquid Surrounded by Another Perfect Fluid. S. Tomotika. *Phys. Math. Soc., Japan, Proc.* 18. *pp.* 550–562, *Oct.*, 1936. *In English.*—The instability of an infinitely long cylindrical column of an incompressible perfect liquid surrounded by another incompressible perfect fluid is discussed with the view to finding out how the mode of maximum instability of the column is affected by the inertia of the surrounding fluid. It is shown that when the inertia of the surrounding fluid is less than, or equal to, the inertia of the liquid in the column, the effects of the former are negligibly small, and that even when the outside inertia is a few times greater than the inside inertia the said effects are also very small. [See also Abstract 2839 (1935).] AUTHOR.

5414. Two- and Three-Dimensional Flow of Viscous Incompressible Fluid, without Inertia, between Eccentric Rotating Cylinders. Part II. Three-Dimensional Flow for Complete Ring. H. Reissner. *Zeits. f. angew. Math. u. Mechanik*, 16. *pp.* 275–286, *Oct.*, 1936.—This paper, which is the second of a series intended as a contribution to lubrication theory, contains the mathematical solution of the equations of steady motion, with inertia terms neglected, of a viscous fluid of constant density and viscosity, in the space between two eccentric rotating cylinders of finite length, the distance between them being small. The normal stress component p_{zz} (z axis parallel to the cylinder axes) is to vanish at the ends, and the pressure and velocity components are expanded in Fourier series of multiples of z which satisfy this condition, and also in Fourier series for the azimuth, and the paper is then largely concerned with the intricate work of satisfying the boundary conditions at the cylinder surfaces. One result that emerges is that the stream lines are periodic curves along the axis of z, whose amplitude increases from zero linearly outwards from the middle plane. The periodic character of the stream lines has also been experimentally observed by Vogelpohl. A further communication is intended to deal with the incomplete ring space. [For Part I see Abstract 1416 (1935).] S. G.

***5415. Water-Jet Air Suction Pumps. G. Heinrich.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 3–4. *pp.* 219–238, 1936.—The paper reports a combined theoretical and experimental investigation of the properties and design of water-jet suction pumps, with special reference to the volume of air removed per sec., the flow in the diffusor, the laws of suction for a pressure below atmospheric, and the efficiency of a pump. An example shows how, when the diameter of the water intake is known and the outer diameter of the diffusor has been suitably chosen the formulæ and the data in the paper may be used to calculate the diameter of the narrowest section of the diffusor in order to obtain the greatest efficiency. Experimental and theoretical results are given showing change of efficiency against the volume of water passing per second for constant water pressure for a particular pump so constructed, and the agreement is fair. S. G.

See also Abstracts 5416, 5423.

KINETIC THEORY OF MATTER.

See Abstracts 5386, 5607, 5667.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

5416. New Derivation of the Formula Solving a Kind of Dirichlet's Problem for a Ring Region. S. Tomotika. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 427–435, *Sept.*, 1936.—An expression is found, by the use of Cauchy's theorem and the Riemann-Schwarz principle of reflection, for an analytic function which is everywhere regular in the region between and on two concentric circles, whose real part is assigned on the outer circle and whose imaginary part vanishes on the inner circle. The problem had been previously treated otherwise (and less satisfactorily) by the author [see Abstract 3531 (1932)] with a view to hydrodynamical applications. S. G.

5417. Synthesis of Fourier Series. A. L. Patterson. *Phil. Mag.* 22. *pp.* 753–754, *Nov.*, 1936.—Gives a brief description of a modification of Robertson's scheme [see Abstract 459 (1936)] for the computation of double Fourier series, making use of the method originally suggested by Beevers and Lipson [see Abstract 2320 (1934)]. No constructional details are given. J. S. C.

5418. Laplacian of a Vector Point Function. N. A. Hall and F. Clauser. *Phil. Mag.* 22. *pp.* 967–970, *Nov.*, 1936. *Supplement.*

5419. Differential Equation of Physical Chemistry. O. H. Faxén. *Arkiv. f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 13. [4 *pp.*], 1936. *In German.*—This paper contains the mathematical solution of a problem relating to diffusion and sedimentation in the ultra-centrifuge. This problem was reduced to an integral equation in a former communication [see Abstract 1210 (1930)], but the present method is more direct. The problem itself is the calculation of the disturbing effect of the vessel wall upon diffusion and sedimentation, and is now limited to the effect of the wall which lies next to the axis of rotation, but the method is also suitable for deriving the effect of the most distant wall. The paper is entirely mathematical. H. H. Ho.

5420. Dimensional Coherence between Giorgi Units and Kalantaroff Dimensions. E. Bodea. *Soc. Române Fiz., Bul.* 37. 66. *pp.* 19–43, 1936. *In English.*—The author refers to the distinctive features of the Giorgi metre-kilogramme-second ohm (M.K.S.O.) system of units and its practical advantages over the C.G.S. system, and shows that the inconvenience of fractional exponents in dimensional formulæ, which is not removed by the Giorgi system itself, is eliminated by the Kalantaroff system of dimensions. In this, the TLQϕ system, the fundamentals chosen are time, length, quantity of electricity and magnetic flux. To obtain identity between value equations and magnitude equations, the rule of dimensional coherence must be observed, *i.e.*, the unit used for each physical magnitude must be that which results from substitution of the chosen basic units in the corresponding dimensional formulæ. It is shown that there is perfect dimensional coherence between Kalantaroff's system of dimensions and Giorgi's rational system of units. The practical advantages of the MKSO system of units can therefore be combined with the theoretical advantages of the TLQϕ system of dimensions, incidentally effecting valuable correlation between physical and engineering investigations and measurement. R. E. N.

5421. Classical Electrical Metrology and Derived Systems of Units. G. Giorgi. *R.G.E.* 40. *pp.* 459–468, *Oct.* 10, 1936.—At its plenary session at Scheveningen-La Haye in June, 1935, the International Electrotechnical Commission decided to adopt the M.K.S. (metre, kilogramme, second) system of units proposed by the author in 1901. The selection of a fourth fundamental unit, from among the practical units of electrical quantities to permit the combination of mechanical, geometrical and electrotechnical units in a single absolute system, is under discussion. The author presents an historical review of the origin and development of electrical units since the time of Gauss, referring to the evolution of practical units and the standardisation of international units, the introduction of a fourth fundamental unit, and the question of rationalisation. A useful Bibliography is appended. The M.K.S. system is to be dealt with in a later article. R. E. N.

MECHANICS, CLASSICAL.

5422. Statics and Dynamics of a Plate in the Form of an Infinite Strip. E. Frola. *Accad. Sci. Torino, Atti,* 71. *Disp.* 3*a. pp.* 452–468, *May–Oct.,* 1936.—With the object of obtaining the means of attacking the problems of free transversal vibrations the statical lowering of a plate in the form of an infinite strip is studied, and the analytical expression is obtained by means of a series of Fourier integrals. Amongst the chief results of the treatment of the dynamical problem are: (1) The sheet consisting of an infinite strip possesses characteristic frequencies which can be arranged in a succession of continuous indefinite spectra; (2) Each of such spectra is represented by all the values of the prime numbers greater than one of the frequencies of the beam which is obtained by cutting the plate by two parallel sections perpendicular to the edges. J. J. S.

5423. Periods of Virtual Instability of Projectiles. R. d'Adhémar. *Comptes Rendus,* 203. *pp.* 771–773, *Oct.* 26, 1936.—Expressions are obtained for the motion of a projectile in which the initial perturbation is not large. Cases are considered for turning to right or left and the conditions of the projectile leading to stability are obtained. Equations for the periods of virtual instability are found and the zones of instability established and these are compared with the results of former hypothesis. R. S. R.

5424. Particular Case of Motion in Resisting Medium with Variable (Attracting) Mass. G. Dubošin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 5. *pp.* 211–214, 1936. *In English.*—The equations of motion of a particle, attracted to a spherical body whose mass varies with the time, and moving through an atmosphere whose density varies with the time and whose resistance is proportional to its density and to the velocity of the particle, are solved by quadratures in a special case. This special case corresponds, under certain conditions, to that of a star losing mass by radiation. G. C. McV.

MECHANICS, QUANTUM.

5425. Planck's Quantum and Eddington's Number. L. Laboccetta. *Ricerca Scientifica,* 2. *pp.* 212–215, *Aug.,* 1936.—From considerations of angular momentum and kinetic energy, it is shown that $h/2\pi$ can be regarded as the angular momentum of an aggregate of N^2 elementary particles each equal to the mass m/N^2 of the first photon, where h = Planck's constant, N=Eddington's number, m=the mass of the electron. Hence, if electromagnetic atomic units are used, $h/2\pi$ is a whole number and this number, which is also the square root of the ratio of the mass of the electron to that of the first photon, is Eddington's number, that is, the reciprocal of Sommerfeld's fine structure number. A. J. McC.

5426. Theory of Matrices and Wave Propagation. L. Brillouin. *J. de Physique et le Radium,* 7. *pp.* 401–410, *Oct.,* 1936.—The theory of electrical lines and filters leads to the introduction of matrices of two lines and two columns whose determinant is 1. A physical representation is thus obtained of the properties of the linear group C_2. The propagation of waves along a line of quadripoles leads to an investigation of axes and proper values of the matrix. On passing to continuous lines, matrices with different properties must be introduced giving a linear matrix equation which is more general than the ordinary equations of wave propagation. Examples are given of the generalisation of the equations of Mathieu and Hill (periodic lines), the electron equations of Pauli and Dirac, propagation on polyphase lines, and the propagation of X-rays in crystals. N. M. B.

5427. Two Generalisations of the Wave Equation. C. W. Oseen. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*A*. *No.* 12. [8 *pp.*], 1936. *In French.*—Elementary solutions are deduced for the equations $(a^2+\sum_k(a_k^2x_k^2)\partial^2\phi/\partial t^2-\Delta\phi=0$ and $\partial^2\phi/\partial t^2+2cx_2\,\partial^2\phi/\partial x_1\partial t+c_2^2x_2^2\partial^2\phi/\partial x_1^2-a^2\Delta\phi=0$. N. M. B.

5428. Elliptic Differential Equation in the Problem of Two Centres. N. Svartholm. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 25*B*. *No.* 10. [6 *pp.*], 1936. *In German.*—The Schrödinger equation for a diatomic molecule is reducible to three ordinary differential equations one of which, the elliptic, is studied and its solutions by different investigators are compared. G. C. McV.

5429. Physical Ultimates. F. A. Lindemann. *Phys. Soc., Proc.* 48. *pp.* 815–829, *Nov.* 1, 1936.—The author discusses what fundamental physical concepts are best used in the description of the physical universe. Choosing mass, charge and action as the most appropriate in the light of quantum phenomena, he shows that the idea that action is atomic necessarily links measurements of length with those of momentum. In general, the appropriate physical ultimates which the nature of the physical world compels us to employ, are not those which our habits predispose us to use, viz.: mass, length and time. The quantum paradoxes arise from this cause. Again, the presence of the imaginary unit in quantum mechanics, with its associated "wave" view of matter, is traceable to

the fact pointed out by Minkowski that one of the simplest descriptions of the universe is obtained in terms of a coordinate system in which imaginary time appears on the same footing as spatial distances.
G. C. McV.

See also Abstracts 5328, 5329, 5330, 5331, 5386, 5437, 5523, 5538, 5539, 5650.

RELATIVITY AND ETHER.

5430. Principle of Equivalence and Deduction of Lorentz Transformation. N. R. Sen. *Indian Journ. Phys.* 10. *pp.* 341–351, *Sept.*, 1936.—By postulating a principle of equivalence for only space and time measurements, it is possible to show that (conceding Euclidean geometry and the linearity of space-time transformation) the measurements of time and linear dimensions suffer reciprocal deformations, when the observers are in uniform relative motion. An attempt has been made to deduce the Lorentz transformation by purely deductive reasoning without assuming the first postulate of the constancy of the velocity of light. It is shown that this can be done, either by an extended principle of equivalence supplemented by a principle of continuity, or by assuming that a velocity which is finite with regard to one system is also finite with regard to the other. It then appears that there is a unique maximum velocity which is to be identified with the velocity of light by the Michelson-Morley experiment.
AUTHOR.

5431. New Relativity. D. G. Bourgin. *Phys. Rev.* 50. *pp.* 864–868, *Nov.* 1, 1936.—The Page-Milne relativity theories are shown to imply the continuous group concept in connection with the conditions of equivalence and the one-dimensional problem is studied. Motional invariants are determined. A quadratic form left invariant under permissible motions is found. The expression determined is a proper one for the quadratics given in noninvariant form by Milne and Page. A tentative suggestion is made to extend the theory by making this quadratic form central for correlating observations and the consequences are studied. The form is invariant under a three parameter continuous group though one of the new groups introduced this way seems difficult to interpret physically. The Lorentz transformation is not necessarily part of the group and even when admitted it must be used with care. Nevertheless, another relation similar to that of the Lorentz transformation always exists between coordinate assignments made by two observers, moving in a permissible way, on the set of particles moving with constant velocity relative to one of them. This generalises a result given by Page. A fairly extensive category of motions is taken up in some detail and the motional equations are found. [See also Abstract 2025 (1936.)]
AUTHOR.

5432. Generalisation of Schwarzchild's Internal Solution. V. V. Narlikar. *Phil. Mag.* 22. *pp.* 767–768, *Nov.*, 1936.—It is shown that a generalisation of the Schwarzchild fluid sphere is possible in which either the time-rate of change of the sphere is small, or it is a constant.
G. C. McV.

5433. New Meaning of Gravitation and Some Consequences. F. Tavani. *Phil. Mag.* 22. *pp.* 810–816, *Nov.*, 1936.—Some extension is given of the author's theory of gravitation [see Abstract 1498 (1936)] as a fact or event of space-time, in which space and time meet, becoming the event in question, and the elimination of the concept of force from the gravitation which it was supposed to cause. Hence the phenomena of the physical world must be interpreted free from the idea of a Newtonian force. Considerations are outlined connecting weight, the formation of the orbits described by planets and other bodies in space, and the planetary perturbations from the orbits with the situation arising from the elimination of attractive gravitational forces. N. M. B.

5434. Ring-Singularity in Born's Unitary Theory. Part I. B. S. M. Rao. *Indian Acad. Sci., Proc.* 4*A. pp.* 355–376, *Sept.*, 1936.—The difficulty pointed out by Born in the derivation of Kramer's formulæ on the basis of the Born unified field theory, *viz.*, that particles had to be endowed with both a magnetic and an electric moment, suggested that point singularities were not the appropriate representations of particles. If a ring singularity is used instead, it is possible to obtain finite expressions for the total energy and angular momentum but the spin cannot be deduced. On the other hand an estimate of the radius of the ring-singularity does account for the very high mass of a proton regarded as represented by this singularity. G. C. McV.

5435. Theorem on Action Functions in Born's Field Theory. B. S. M. Rao. *Indian Acad. Sci., Proc.* 4*A. pp.* 377–381, *Sept.*, 1936.—It is proved that there is only one action function in Born's unitary field theory which is both self-conjugate and relativistically invariant, *viz.*, the action function originally put forward by Born himself. G. C. McV.

5436. Identical Relations between the Field Equations in the General Field Theory of Schouten and van Dantzig. N. G. Shabde. *Phil. Mag.* 22. *pp.* 950–954, *Nov.*, 1936. *Supplement.*—Mathematical. [See Abstract 102 (1933).]

5437. Principle of Relativity and General Theory of Evolution of a Physical System. J. L. Destouches. *J. de Physique et le Radium*, 7. *pp.* 427–433, *Oct.*, 1936.—The author develops his theory of the evolution of a physical system and is led to classify such systems into three groups: those whose elements are independent, those whose elements are in interaction and lastly, "joint" systems (*systèmes fondus*). The latter are exemplified by atomic nuclei. Relativity principles are next introduced. One fixes all observers for whom the evolutions of systems are the same, a second defines the means of signalling between observers and a third principle fixes the form of the operator defining an isolated particle. G. C. McV.

SOLUTION.

5438. Solubility of Deuterium and of Hydrogen in Palladium. A. Sieverts and W. Danz. *Zeits. f. phys. Chem.* 34. *Abt.B.* 1–2. *pp.* 158–159, 1936.—Previously published solubility studies from 300–1100° C. [see Abstract 4872 (1935)] are extended into the temperature range 20°–400° C. There is a great change in solubility of H_2 at about 140° and a similar change in that of D_2 at about 100°; between these temperatures the solubility ratio of H_2/D_2 (about 20/1) is sufficient to foreshadow a possible method of separation of the isotopes. L. V. C.

5439. Solubility of Solids in Liquefied Gases. A. I. Schattenstein and M. M. Wiktorow. *Acta Physicochimica*, 5. 1. *pp.* 45–62, 1936. *In German.*—The solubility of KNO_3 and NaCl in liquid NH_3 at 0·12° and 25·0° C. is determined by a method avoiding a number of sources of error which affected previous determinations, which were critically studied. KNO_3 is considered a good standard for testing future methods owing to its low temperature coefficient of solubility; its solubility at 0° C. is given as 9·59 ±0·03 gm./100 gm. solution. L. V. C.

5440. Effect of One Salt on the Solubility of Another. Part VII. J. R. Partington and H. J. Stonehill. *Phil. Mag.* 22. *pp.* 857–882, *Nov.*, 1936. *Supplement.*—The solubilities of *iso*-thiocyanato-pentammine-cobaltic nitrate and *iso*-thiocyanato-pentammine-cobaltic iodide are determined in the presence of Na, K and Ba thiocyanates. Neither the simple limiting law of Debye and Hückel (point-ions) nor the first Debye-Hückel approximation (finite ion diameters) provide a satisfactory explanation of the experimental results. The modification due to Hückel, introducing the effect of concentration on dielectric constant, is also unsatisfactory. The La Mer equation for unsymmetrical electrolytes gives a satisfactory explanation of the experimental data for ionic strengths up to at least 0·52, provided it is not assumed that $a = a_0$ in calculating mean ionic diameters, or that the mean ionic diameters calculated for mixed electrolytes in solution have any physical relation to crystallographic ionic diameters of individual ions. [For Part VI see Abstract 125 (1935).]
AUTHORS.

5441. Solubility of Mercurous Sulphate in H_2SO_4 Solutions. D. N. Craig, G. W. Vinal and F. E. Vinal. *Bureau of Standards, J. of Research,* 17. *pp.* 709–720, *Nov.*, 1936.—Although mercurous sulphate has been the subject of many papers, particularly as to its use in standard cells, the information available in the technical literature about its solubility in dilute solutions of H_2SO_4 is somewhat conflicting and incomplete. New determinations have been made, therefore, of the solubility of the salt at 28° C. and at 0° C. About half of the determinations at each temperature were made on solutions which were brought to saturation from an undersaturated state and the others from an initially supersaturated state. The mercury was determined electrolytically. Each solution was tested after electrolysis for residual mercury. Errors which might arise from the presence of mercuric mercury were shown to be within the limit of experimental error of the determinations. The acid concentration of the solutions ranged from 0·001 to 4 molar. Tables are given for the solubility of the salt in these solutions. The trend of the curves is discussed and comparisons are made with data previously obtained by others.
AUTHORS.

See also Abstracts 5389, 5543, 5544, 5614, 5615.

SURFACE TENSION AND COHESION.

5442. Surface Tension of Aqueous Solutions of Dipolar Ions. J. R. Pappenheimer, M. P. Lepie and J. Wyman, Jr. *Am. Chem. Soc., J.* 58. *pp.* 1851–1855, *Oct.*, 1936.—Measurements of the surface tension of aqueous solutions of seven amino acids of differing size and moment and of glycine betaine are made with the drop weight method. In the case of four of the amino acids the surface tension is greater than that of water; in the other cases it is less. In these dipolar ions there appears to be an antagonism between the effect of the electric moment which tends to increase the surface tension, and the size and number of organic groups in the molecule which tend to lower it. The effect of converting an amino acid into its hydrochloride or its sodium salt is to lower the surface tension of the solution.
AUTHORS.

5443. Surface Tension of a Moving Mercury Sheet. H. O. Puls. *Phil. Mag.* 22. *pp.* 970–982, *Nov.*, 1936. *Supplement.*—Bond's method of using the impact of two liquid jets for the determination of surface tensions is applied to Hg. The Hg is circulated, and a device for the continuous measurement of the rate of flow of the liquid is described. A method for determining the momentum of the jet is developed, from which the radius of the jet is deduced. The value of the surface tension of Hg in contact with air at 20° C. is given as 475·5 ± 2 dynes/cm. A survey of the results of other workers is added. AUTHOR.

5444. Surface Activity of Non-Polar Molecules of Hydrocarbons. Part I. A. Taubmann. *Acta Physicochimica,* 5. 3. *pp.* 355–380, 1936. *In English.*—The surface activity of a number of cyclic and fatty hydrocarbons and of some of their Cl derivatives is investigated by obtaining the surface tension isotherms of their solutions at liquid-liquid (paraffin oil-water) and liquid-gas (nitrobenzene-air) interfaces. It is shown that in the case of sufficient differences in polarities at interfaces for which the rule of equalisation of polarities is satisfied, the non-polar molecules of hydrocarbons are surface-active and yield typical adsorption isotherms which obey the Langmuir-Szyszkowski equation. For the various homologous series of hydrocarbons investigated, the increase in surface activity follows the Traube rule, though with different coefficients. The molecular constants of the adsorption layer are calculated, from which it is ascertained that, in an adsorption layer, non-polar molecules assume horizontal positions which they retain at all the stages of condensation until the layer is saturated. It is shown that the usual equation of state of two-dimensional layers is applicable to the adsorption layers of hydrocarbons. H. H. Ho.

5445. Free Surface Energy of Solids. F. E. Bartell, J. L. Culbertson, and M. A. Miller. *J. Phys. Chem.* 40. *pp.* 881–904, *Oct.,* **1936.**—For the rapid measurement of solid-liquid-air and solid-water-organic liquid contact angles a solid rod was placed vertically through the liquid surface and viewed through a horizontal microscope. The arrangement of the containing vessels was appropriate to the particular system under investigation. Pyrex, silica, Au, and Pt rods were used. The presence of strains in glass appears to account for the large water-air contact angles observed on strained glass ; removal of strain reduced the contact angle to zero. Standard surfaces for reference were produced from scraped rods of Au and Pt subjected to heat treatment in air at 100° to 600° C. Low-temperature treatment produced fairly strong organophilic surfaces, and higher temperatures tended to produce hydrophilic surfaces. The changes were probably due to oxidation and recrystallisation, and the surface properties were found to alter with time after heat treatment. A standard surface could not be produced on rods of steel heat treated in air. Scraping and treatment *in vacuo* caused rods of Au, Pt, Cu, stainless steel, Ag, Al and brass to become more hydrophilic with increasing temperature of treatment. Heat treatment *in vacuo* H_2, air, and N_2 produced surfaces which were progressively less hydrophilic, and the treated surfaces had unusual chemical reactions with organic liquids. The wetting characteristics depend strongly on the precise pretreatment of the metal. P. H. B.

5446. Studies of Monomolecular Films by the Ripple Method. J. Sameshima and T. Sasaki. *Chem. Soc., Japan, Bull.* 11. *pp.* 539–552, *Aug.,* 1936. *In English.*—The amplitude l of ripples set up by a tuning fork on the surface of water in a shallow tray is studied, as a function of the surface concentration a of oils, etc., added in dilute solution in volatile solvents. Working with " constant surface area," the l-a curves show a sharp discontinuity at values of a corresponding to a monomolecular film of the oil. The molecular areas deduced (for palmitonitrile, tetradecyl alcohol, and myristic, palmitic, stearic and oleic acids) agree with those given by the methods of Langmuir and Adam. In the case of oleic acid the critical value of a depends on the pH of the water; in all cases, working at " constant oil quantity " and varying the effective surface area, there is a hysteresis as between the compression and expansion curves. The method is applied to determine the molecular weight (3600) of mastic. L. V. C.

5447. Film Formation in Emulsions. H. Wagner and G. Fischer. *Kolloid Zeits.* 77. *pp.* 12–20, *Oct.*, 1936.—Films formed in emulsions are described and classified. A new method of testing stability is described. P. H. B.

See also Abstracts 5320, 5326, 5376, 5682.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

5448. Measurement of Short Intervals of Time. H. Schardin. *Forsch. IngWes.* 7. *pp.* 257–264, *Nov.–Dec.*, 1936.—Brief references are made to the known methods of measuring intervals of time up to about one second. P. H. B.

VACUA, HIGH.

See Abstract 5642.

VISCOSITY, FRICTION AND LUBRICATION.

5449. Influence of a Magnetic Field on the Viscosity of Liquids. Part II. S. D. Chatterjee. *Indian Journ. Phys.* 10. *pp.* 399–401, *Sept.*, 1936.—The present paper describes the effect of a magnetic field on the viscosity of a few non-polar liquids and monohydric alcohols. The former show no change, while the change observed in the latter seems to depend upon the shape of the molecule, *e.g.*, on the presence of a straight chain, a side chain or general symmetry of structure. [For Part I see Abstract 4127 (1935).] AUTHOR.

5450. Viscosity of Gases and Sutherland's Constant. A. Fortier. *Comptes Rendus*, 203. *pp.* 711–712, *Oct.* 19, 1936.—The most precise measurements of viscosity η and temperature T only permit Sutherland's " constant" C, given by $\eta_T/\eta_0=\sqrt{T/T_0}(1+C/T_0/(1+C/T)$, to be determined to within a few per cent. Thus the author's data for air, with η precise to 1 in 2000 [see Abstract 491 (1936)], give the values of C, 115 employing η_{-180} and η_{-80}, 120 employing η_{-80} and η_{-20}, and 104 employing η_{-20} and η_{+20}. L. V. C.

5451. Rapid Measurement of Oxidation of Insulating Oils in Air. A. Gemant. *Faraday Soc., Trans.* 32. *pp.* 1628–1633, *Nov.*, 1936.—If oil is oxidised at about 150° C. under constant pressure in a relatively small closed space, and the decrease of the volume of the gas phase is plotted against time, curves are obtained which vary characteristically with the grade of the oil. The changes are the less pronounced, the curves the flatter, the poorer the oil, owing probably to production of volatile products, counteracting the effect of absorption of oxygen. The method seems to be suitable for the rapid testing of the stability of oils. AUTHOR.

See also Abstract 5414.

ASTRONOMY AND ASTROPHYSICS.

COSMOGONY.

5452. Observational Basis for the Red-Shift in the Spectra of Spiral Nebulæ. P. ten Bruggencate. *Naturwiss.* 24. *pp.* 609–615, *Sept.* 25, 1936.—A popular account of present state of the observational material connected with spiral nebulæ is given. The distribution in the sky, the relation between the number of nebulæ and their apparent magnitudes, the clusters of nebulæ and the amount of the red-shift in their spectra are discussed. It is pointed out how, on the basis of a uniform distribution of nebulæ in space, nebular counts could discriminate between the statical or the expanding characters of space. G. C. McV.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstracts 5424, 5456.

NEBULÆ.

5453. Effect of Space Reddening on the Balmer Decrement in Planetary Nebulæ. L. Berman. *Roy. Astron. Soc., M.N.* 96. *pp.* 890–899, *Oct.*, 1936. *Supplement.*—From the distances of the planetary nebulæ and an effective width of 400 parsecs for the absorbing layer, it is shown that (1) the observed H line intensities grow progressively fainter with increasing path-length of the nebular light through the absorbing medium (general absorption), and (2) the weakening of the lines is accelerated towards the u.v. (selective absorption). From the observed data, the coefficient of absorption, relative to Hβ, is found to be $k\lambda=0\cdot53\ (4862/\lambda)^{2\cdot27}$, where $0\cdot53$ is the absorption constant to Hβ, expressed in magnitudes, per kiloparsec. Except for a small difference which may be attributed to self-reversal, the observed Balmer line decrement, corrected for absorption, is in satisfactory accord with theory.

AUTHOR.

5454. Surface Brightness and Cosmic Absorption in the Spiral Nebulæ. M. S. Eigenson. *Zeits. f. Astrophysik*, 13. 1. *p.* 88, 1936.—Corrections in the original [see Abstract 4056 (1936)].

See also Abstract 5452.

PLANETS.

5455. Internal Constitution of the Planets. D. S. Kothari. *Roy. Astron. Soc., M.N.* 96. *pp.* 833–843, *Oct.*, 1936. *Supplement.*—The paper consists of three parts. (1) The present theory of white dwarf stars is summarised. The relation between the mass M and the radius R of agglomerations of degenerate ionised matter is shown to be in accordance with observations of white dwarfs. The theory fails, however, with the planets, the theoretical radii being 100 times too small. The failure is shown to be due to the assumption that the degree of pressure-ionisation is independent of the mass of the agglomeration. (2) A more general theory is evolved without this restriction. This theory gives the ordinary mass-radius relation and *predicts*, not merely assumes, complete ionisation of the matter in white dwarfs. (3) Numerical results are given for chemical compositions of Fe and of H, and a theoretical (M,R) diagram is constructed for both assumptions. With one exception, all the observed white dwarfs and all the planets fall in the region between the Fe and H curves. The implication is that planets may be regarded as "black dwarfs." A. Hu.

5456. Advance of the Node of a Planet's Orbit under the Action of a Circular Ring. J. Chazy. *Comptes Rendus*, 203. *pp*. 706–709, *Oct*. 19, 1936.—The author compares his method for dealing with this problem with that of Fatou. G. C. McV.

STARS.

5457. Stellar Parallaxes with 60- and 100-in. Reflectors. A. van Maanen. *Mt. Wilson Observat., Contrib. No.* 553. *Astrophys. J.* 84. *pp*. 409–411, *Nov*., 1936.—Results are given for 25 fields including 26 stars, 10 of which have photographic absolute magnitudes of + 10 or fainter; 2 are fainter even than + 15. One white dwarf is included, Ross 627, for which the spectrum, according to Humason is A0, while the absolute magnitude is + 13·8. Also included are 3 stars of peculiar spectrum (put on the programme at the request of Merrill), 2 planetaries, and 1 Nova, Nova Geminorum 1912. AUTHOR.

5458. Absolute Magnitude Distribution. G. Strömberg. *Mt. Wilson Observat. Contrib. No.* 554. *Astrophys. J.* 84. *pp*. 412–432, *Nov*., 1936.—The method is now applied to G8–K2 stars brighter than m 5·8, and of a certain range in spectroscopic M. The independent determinations of luminosity distribution, corresponding to velocity components along three mutually perpendicular axes are in fair agreement, and show that most have M very close to 0·6. A group of sub-giants of $M = +2·3$, separated from normal giants by a frequency minimum, appear in all three solutions, and are somewhat brighter than the spectroscopically determined values. [See also Abstracts 3374 (1930), 1155 and 2787 (1932).] A. S. D. M.

5459. Fourier Constants of a Drift Curve. A. Fletcher. *Roy. Astron. Soc., M.N.* 96. *pp*. 877–881, *Oct*., 1936. *Supplement*.—A general expression for any one of the Fourier coefficients is found in terms of modified Bessel functions. The first four coefficients are worked out numerically. G. C. McV.

5460. Time Effects in Spectrophotometry. W. M. H. Greaves. *Roy. Astron. Soc., M.N.* 96. *pp*. 825–833, *Oct*., 1936. *Supplement*.—The Kron-Halm modification of the Schwarzschild law is considered from the point of view of the astrophysicist. It is pointed out that the intensity which gives maximum photographic effect for a given energy is greater than those normally encountered in astronomical spectrophotometry. In the limited range of the variables which is employed in practice, reciprocity failure curves are represented more accurately by parabolæ than by the Kron-Halm logarithmic catenaries. The law of photographic action proposed is $f(D) = y + ax - bx^2$, where $x = \log I$ and $y = \log It$. The errors involved in using the simple Schwarzschild law when plates are calibrated with different exposure times are derived; and simple formulæ are given, in terms of observable emulsion constants, for correcting spectrophotometric observations for time effects. Numerical applications to the subjects of line profiles, of colour temperatures, and of spectrophotometry of the continuous spectrum, are discussed. A. Hu.

5461. Profile of Absorption Lines in Rotating Stars, Taking into Account the Variation of Ionisation Due to Centrifugal Force. P. Swings and S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 96. *pp.* 883–889, *Oct.*, 1936. *Supplement.*—In certain A and B stars having high rotational velocities the ratio of centrifugal acceleration to surface gravity ϵ is of the order of 1/2. The centrifugal acceleration reduces the gravity in dependence on stellar latitude for high ϵ values. The resultant variation of ionisation with latitude gives rise to differences between the profiles of lines of neutral and ionised atoms. The differences in profile to be expected are calculated theoretically for several sets of particular conditions. J. E. K.

***5462. Photoelectric Photometry at Sproul Observatory. J. S. Hall.** *Astrophys. J.* 84. *pp.* 369–408, *Nov.*, 1936.—A plate shows a device for measuring the intensity of both first-order spectra simultaneously. To test the efficacy, the magnitude difference between Vega and β Pegasi as a function of the wave-length was found on several nights ; a graph shows that they are of equal brightness at 8250 Å ; if both stars are black bodies, and if β Pegasi has a surface temperature of 3000° K., Vega must be near 11,000° K. Colours from three sources are combined with three spectral classifications to form mean colour excesses. That of giant K1–M0 stars is definitely related to trigonometric M ; the correlation for G4–K0 stars is weak. A table is given for 285 stars, of colour observations between effective wave-lengths, 6800 and 8300 Å, giving magnitudes (Ptg, Vis, infr), spectrum (according to Victoria, Mt. Wilson, Harvard), mean C.E., parallax (π_c, π_v, π_t), and Vis Mc. The method of determining M from colour excess is similar in some respects to the spectroscopic. There is no evidence of interstellar scattering. [See also Abstract 990 (1934).] A. S. D. M.

5463. Equivalent Breadths of Absorption Lines. D. H. Menzel. *Astrophys. J.* 84. *pp.* 462–473, *Nov.*, 1936.—Formulæ relating the theoretical strength of a line to its equivalent breadth, W, are developed. Allen's empirical discovery, that $W\lambda$ rather than W must be employed when lines of various spectral regions are to be related to one another, is explained theoretically. By means of the formulæ referred to above, a theoretical curve of growth is constructed for Fe 1 at a temperature of 5740°. The agreement with Allen's empirical curve is surprisingly close when we consider the elementary character of the assumptions and the approximations used in obtaining the equations. The effect of a variable opacity on the lines of neutral and ionised elements is examined. It is shown that lines of both neutral and ionised atoms should be strongest at the frequency of maximum spectral intensity. Toward the violet or the red the lines of neutral elements should decrease in intensity more rapidly than those of the ionised elements. AUTHOR.

5464. Equivalent Breadths of Absorption Lines. J. G. Baker. *Astrophys. J.* 84. *pp.* 474–476, *Nov.*, 1936.—A formula is derived for the curve of growth of a stellar absorption line. The results, shown in graphical form, agree satisfactorily with equivalent breadths computed by numerical integration from the line-absorption coefficient. AUTHOR.

5465. Continuous Hydrogen Absorption of cF Stars. Y. Öhman and Wilhelmina Iwanowska. *Arkiv f. Mat. Astron. och Fysik, Stockholm.* 25*B*. *No.* 7. [6 *pp.*], 1936. *In English.*—New material from Stockholm plates was used for the three wave-lengths, λλλ 4400, 4030, 3670, and gives the quantity, $A = c_v - 1{\cdot}173c_b$ as a measure of the continuous H absorption, the factor 1·173 being the ratio, (1/3670 − 1/4030) : (1/4030 − 1/4400). The continuous H absorption is a sensitive measure of luminosity for F type stars, increasing steadily with increasing luminosity, and for cF stars is as strong as for ordinary A type ; but with decreasing temperature it weakens and does not show up in cGO stars. The luminosity effect in this continuous absorption probably depends on the number of H atoms in the photospheric quantum level. Above 9000° T. this is independent of surface *g*, but in F type (notably) it is dependent. For cF stars, Stark effect probably causes the same dependence of luminosity effect in H lines on continuous absorption. B and A stars show the Stark broadening as giving rise to a very strong luminosity effect : increasing H line intensity = decreasing luminosity. [See Abstract 3795 (1935).] A. S. D. M.

5466. Structure of the Atmosphere of ζ Aurigæ. D. H. Menzel. *Harvard Coll. Obs. Circ. No.* 417. [9 *pp*.], 1936.—The K-component of the eclipsing variable ζ Aur. has an extended chromosphere which produces gradual extinction of the light of the B-component, from both general and line absorption, as eclipse is approached. On the assumption that the opacity is produced by pure absorption in an ionised atmosphere, a general expression is deduced for the optical depth, and theoretical light curves are drawn. At the base of the atmosphere the number of electrons per cc. is found to be $6 \cdot 3 \times 10^9$, with an exponential gradient of -8×10^{-13}/cm. rise. By assuming that line breadths are due to radiation damping, an electron density of $7 \cdot 3 \times 10^9/\mathrm{cm.}^3$ is obtained ; Doppler broadening leads to a value of the order of $10^8/\mathrm{cm}^3$. The sharpness of the lines favours the first assumption. The ratio of the radii of the two components is given as $R_K/R_B = 63$, a value some 3 times larger than that obtained by assuming sharp occultation. A. Hu.

5467. Internal Constitution of Eclipsing Binaries. Z. Kopal. *Roy. Astron. Soc., M.N.* 96. *pp*. 854–862, *Oct*., 1936. *Supplement*.—The underlying physical problem in the present paper was to obtain some general idea regarding the density concentration in the interiors of stars, using eclipsing binaries as material. The investigation has led to the following conclusions : (1) The density concentration depends on the age of the system. The components of a new-born binary are homogeneous or nearly homogeneous. (2) As time elapses, the density concentration begins to become appreciable, and at the end of the evolution of a system both components come close to the model requiring a high density concentration. (3) The stars of the main sequence show an increase of the density concentration with advancing spectral type. These conclusions may be generalised to spectroscopic binaries. AUTHOR.

5468. Survey of Variable Stars in Milky Way Fields 233 and 187. Henrietta H. Swope. *Harvard Coll. Obs., Ann.* 90. 7. *pp*. 207–229, 1936.

5469. Observations of Variable Stars by the American Association of Variable Star Observers. L. Campbell. *Harvard Coll. Obs., Ann.* 104. 2. *pp*. 33–57, 1936. [See also Abstract 3100 (1936).]

5470. Henry Draper Extension. Annie J. Cannon. *Harvard Coll. Obs., Ann.* 100. 6. *pp*. 205–226, 1936.

5471. Fourth Catalogue of Spectroscopic Binary Stars. J. H. Moore. *Lick Observat. Bull.* No. 483. [38 *pp*.], 1936.

See also Abstract 5538.

SUN.

5472. Physical State of the Solar Chromosphere. G. G. Cillié and D. H. Menzel. *Harvard Coll. Obs. Circ. No.* 410. [40 *pp.*], 1936.—The authors examine photometrically some 160 flash spectra, taken near third contact during the 1932 eclipse, on two "jumping film" spectrographs. The spectra were taken at 2·4 sec. intervals and cover the range 3200–6800 Å. An absolute calibration of line intensities is obtained by comparison with the continuous spectrum ; the values agree satisfactorily with the 1927 observations. Line intensities and emission gradients for a normal and for an abnormally excited region are given. The effect of self-reversal due both to wing scattering and to scattering in the Doppler core is discussed. From the observed gradients and intensities of the H and K lines, the number of Ca^+ ions per unit radial column of the chromosphere is found to be 2×10^{16}. The corresponding number of 2-quantum H atoms is 2×10^{12}, and of electrons is $5{\cdot}2 \times 10^{19}$. Anomalous multiplet intensities in the chromosphere are attributed chiefly to self-reversal. Excitation of H and He atoms is probably due to photospheric radiation. A. Hu.

5473. Fraunhofer Intensities in the Infra-Red. C. W. Allen. *Roy. Astron. Soc., M.N.* 96. *pp.* 843–853, *Oct.*, 1936. *Supplement.*—Intensity observations on 300 lines in the region 6600–8900 Å of the solar spectrum are tabulated. The spectra were obtained in the first order of a 21-ft. concave grating, and standardised either by means of neutral screens of known opacity, or by utilising the intensity distribution along the astigmatically lengthened lines, or with a tube sensitometer provided with an infra-red filter. Equivalent breadths found directly from the contours of some 100 lines are used to deduce values for the others from their central intensities. In the mean, the equivalent breadths are 10 % smaller than Mulders' values. The Revised Rowland intensity scale is evaluated in terms of equivalent breadths, as is also a forthcoming scale of Babcock and Moore. A discontinuity at 7200 Å in the former is shown to have been removed in the latter. A. Hu.

See also Abstracts 5701, 5702.

GEOPHYSICS.

GEODESY.

5474. Geoid Determination from Gravity Measurements. B. V. Numerov and D. Chramov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 265–268, 1936. *In German.*—The gravitational potential is expressed by means of spherical harmonics (to the 4th order) with latitude and longitude as variables. Successive approximations based on gravity determinations at a sufficient number of places then enable the form of the general geoid to be deduced. [See following Abstract.] C. A. S.

5475. Geoid Determination from Gravimetric and Astronomical Geodetic Observations. B. V. Numerov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 269–270, 1936. *In German.*—The form of the general geoid having been determined [see preceding Abstract] the local " undulations " thereof are determined by comparing at accurately fixed points the actual local direction, etc., of gravity with astronomical observations. C. A. S.

See also Abstract 5405.

GEOPHYSICS, APPLIED.

5476. Electromagnetic A.C. Prospecting at Very Low Frequency. S. S. Stefanescu. *Beitr. z. angew. Geophys.* 6. 2. *pp.* 168–201, 1936. *In French.*—Starting with magnetic and electric fields as a sine curve a.c. *régime* two new vectorial fields, M and N, are defined as the limiting values of the derivatives of the former with respect to the frequency, when this tends to zero. For the inductive methods, the field M in the air is derived from a Newtonian potential of a vertical cylinder having as a base the inductor, the density of which at a depth 2 h. equals the conductivity of the ground at a depth h. Thus for calculation of M only a Newtonian potential outside the attractive mass is required. For components of M various apparent conductivities at the surface are connected by linear integral equations with values below the ground. With a measuring device expanding homothetically with respect to a fixed point all cases of stratification can be derived from a single chart consisting of a simple line. The vertical component M_z in the case of a bipole and a rectilinear transmitter with earth contact is also studied. The field N of an inductor is not influenced by horizontal stratification. Assuming the existence of vectors M and N the equations with partial derivatives are given which satisfy the fields for a certain isotropic heterogeneous medium. R. S. R.

5477. Seismic Field Methods. B. Gutenberg. *Beitr. z. angew. Geophys.* 6. 2. *pp.* 125–140, 1936. *In English.*—The periods of longitudinal waves produced by explosions increase with distance in a similar way to earthquake waves. The amplitudes of the waves depend not only on the amount of energy reflected or refracted at discontinuities, but also on the angle of incidence at the instruments and its rate of change with distance. Calculation on the relative amplitudes of direct, reflected and refracted waves are in agreement with the observations. Formulae are given to calculate the approximate dip of discontinuities using either the distance at which the travel time of the reflected wave is a minimum or the difference in travel time between two instruments, especially at two opposite sides of the shot point, or the direction of the travel time curve at the shot point. The surface waves (ground roll) recorded from explosions can hardly be pure elastic waves; their velocity is too small for either Love- or Rayleigh-waves. AUTHOR.

LAND, PHYSICS OF THE.

5478. Moving Continents. A. Prey. *Gerlands Beitr. z. Geophys.* 48. 4. *pp*. 349–387, 1936.—The author calculates the force driving a continent towards the pole. He finds that there would be small movements of translation and rotation. The effect is very small and he concludes that the continent would not move at all. W. A. R.

See also Abstracts 5495, 5496, 5590.

METEOROLOGY.

5479. Conference on Atmospheric Ozone, Held at Oxford, Sept. 9th to 11th, 1936. *Roy. Meteorolog. Soc., J.* 62. [76 *pp*.], 1936. *Supplement*.—A series of 29 papers under the following 5 headings, followed by a General Discussion under each heading:

(A) Methods of Measurement of Ozone. Papers by: **D. Chalonge; J. Guéron et M. Prettre; J. Gauzit; V. H. Regener; G. M. B. Dobson.**

(B) Vertical Distribution of Ozone. Papers by: **G. M. B. Dobson; B. O'Brien and F. L. Mohler; O. R. Wulf and L. S. Deming.**

(C) Absorption of Radiation and Temperature of the Upper Atmosphere. Papers by: **F. J. W. Whipple; E. V. Appleton; E. Vassy; J. Dufay; E. H. Gowan; R. Penndorf; F. W. P. Götz; R. Ladenburg; A. Eucken and F. Patat; E. Vassy.**

(D) Horizontal Distribution of Ozone and Weather Conditions. Papers by: **G. M. B. Dobson; D. Chalonge; E. Tonsberg and D. Chalonge; P. Lejay; A. R. Meetham.**

(E) General. Papers by: **S. Chapman; D. Eropkin; E. Vassy; J. Cabannes and H. Garrigue; E. Regener; F. W. P. Götz and W. Zunti.**

5480. Kinematical Analysis of the Field of Pressure. H. Arakawa. *Phys. Math. Soc., Japan, Proc.* 18. *pp*. 460–468, *Sept.*, 1936.—The path of a pressure centre is considered mathematically and the following rules are obtained: (1) when the tendency profiles are curved cyclonically a cyclonic centre is retarded, will recurve in future, and gradually increase in strength while an anticyclonic centre is accelerated, does not recurve, and decreases in strength; (2) when the tendency profiles are curved anticyclonically the action of the cyclonic and anticyclonic centres is the reverse. These rules are applied to tropical cyclones. The path of an isobar is next considered. Finally the generation of a col and its possible development into a cyclonic or anticyclonic centre is treated. R. S. R.

5481. Wind Conditions of the Arlberg. Part I. Surface Observations. E. Ekhart. *Gerlands Beitr. z. Geophys.* 48. 4 *pp*. 313–324, 1936.—On the basis of ground observations at the three stations, St. Anton, St. Christoph and Stuben proof is obtained that the local winds of the Arlberg are most probably of the Maloja type, a result in agreement with theory. In addition the individual peculiarities of the diurnal wind changes at these stations are analysed. Further considerations relating to these ideas will be given in the aerological part of the investigation later. R. S. R.

5482. Advances and Developments in Weather Forecasting. R. H. Weightman. *Frank. Inst., J.* 222. *pp.* 527–550, *Nov.*, 1936.—After a historical introduction on methods of forecasting and the methods by which the vertical structure of cyclonic and anticyclones were determined, the Bjerknes cyclone model is explained. A general description of air mass analysis and the T–ϕ diagram is given. Finally Tetterssen's kinematical methods for weather forecasting are explained. R. S. R.

5483. Colour Measurement as a Meteorological Observation. W. Kühnert. *Gerlands Beitr. z. Geophys.* 48. 4. *pp.* 325–348, 1936.—Examples are given of the different colours at sunset and in the forenoon and in different meridians, the differences being caused by dust. For cloudless or nearly cloudless skies successive observations of turbidity were made in the zenith and near the horizon these observations being limited to occasions of polar or descending air. The procedure for obtaining the colour and clearness in the horizontal is explained and is based on differences of colour of near and distant objects, while the use of an instrument for this purpose is explained. The theoretical basis used for colour is that of Young-Helmholtz. Further measurements are to be undertaken. R. S. R.

See also Abstract 5620.

SEISMOLOGY.

5484. Damping of Seismic Vibrations of a Surface Layer Due to Obliquely Incident Disturbance. K. Sezawa and K. Kanai *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 354–359, *Sept.*, 1936. *In English.*—The case is considered of distortional waves with horizontal disturbance [see Abstract 4923 (1935)]. C. A. S.

5485. Stiffness of Floors. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 367–376, *Sept.*, 1936. *In English.*—Previous work [see Abstracts 3573 and 4114 (1936)] is applied to a multi-span framed structure, and it is found that the effective stiffness of the floors is very small. W. A. R.

5486. Seismic Vibrations in Actual Buildings. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 377–386, *Sept.*, 1936. *In English.*—The improved theory of the authors [see Abstract 4114 (1936)] is applied to the energy dissipation in the seismic vibrations of actual buildings. Every maximum bending moment induced in columns lies within a certain specified range of resonance curves. The theory explains the fact that the columns, most damaged in the case of great earthquakes, were those on floors a few stories above ground level. W. A. R.

5487. Observed Vibrations in Buildings. D. S. Carder. *Seismological Soc. of America, Bull.* 26. *pp.* 245–277, *July*, 1936.—Observations of the vibration periods of a number of structures are recorded. A set was carried out on the Almeda County Court House at different times during construction. Simultaneous vibration observations on a number of buildings in California, when under the action of wind, are given.

Application of the results is made to the effects of the Montana earthquake, 1935. W. A. R.

5488. Experiments on Fall of Columns. T. Clements. *Seismological Soc. of America, Bull.* 26. *pp.* 229–234, *July,* 1936.—To test the possibility of inferring the position of the epicentre of an earthquake from the direction of fall of buildings near thereto, 100 columns (wooden cylinders 10 in. × $1\frac{1}{4}$ in.) were placed along eight radii from the place where 25 lb. dynamite was exploded and the direction of fall observed; 85 % fell towards the epicentre of which 81 % fell within 30° of the direction thereof (57 % within 15°). It seems therefore safe to conclude that free falling columns near the epicentre tend to fall more nearly towards or away therefrom. C. A. S.

5489. Statistical Investigation of Earthquake Phenomena. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 399–414, *Sept.,* 1936. *In English.*—The following main relations are investigated: (1) tidal phases and earthquakes, (2) time and space distribution of earthquakes, and (3) cyclone tracks, atmospheric pressure distribution and earthquakes. A maximum of earthquakes is found near to low water and a secondary maximum about $1\frac{1}{2}$ hours later. A frequency of 27·5 days is found for great earthquakes which is probably related to the rotation of the sun, and the great eruption of H_2, with this frequency. For (3) a long period is indicated superimposed on an annual period having a positive correlation for deep and a negative correlation for "felt" earthquakes. The maximum effect of earth stress due to cyclones occurs about 900 km. from the cyclonic centre. R. S. R.

***5490. Experimental Solution of Equation of Motion of the Seismograph. T. Fuchida.** *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 415–419, *Sept.,* 1936. *In English.*—Numerical calculation to solve the equation of motion of the seismograph $\ddot{x} + 2\epsilon\dot{x} + n^2x = f''(t)$ cannot be employed when $f''(t)$ is very complicated. This is solved by an experimental method for all cases of $f''(t)$ for the initial conditions $x = 0$, $\dot{x} = 0$, at $t = 0$. A sensitive galvanometer of the moving coil type was used to measure the weak d.c. or the ballistic current and the transient motion in the oscillation of the galvanometer suspension was used in the experiment. Details of the experimental arrangement are supplied and several examples of the results are shown. R. S. R.

***5491. Initial Motion of Seismographs. Parts I and II. H. Kawasumi and Z. Kinosita.** *Tokyo Univ. Earthquake Research Inst., Bull.* 14. *pp.* 319–353, *Sept.,* 1936. *In English.*—The motions of seismographs of ordinary type and of those of Galitzin caused by ground motion $\sigma = 3\sin pt - \sin 3pt$ are calculated. Thence a method for reducing the first impulse of an earthquake with fair accuracy is deduced. The results are tested experimentally by comparing them with seismograms as recorded by an Ishimoto acceleration-, and Hagiwara velocity- and displacement-seismographs on a shaking table. C. A. S.

***5492. Machine for Reproducing Earthquake Motions. A. C. Ruge.** *Seismological Soc. of America, Bull.* 26. *pp.* 201–205, *July,* 1936.—The driving power is derived from oil under pressure working against a piston connected with the moving table, the flow of oil being controlled by a valve. To control this last a plot of the earthquake motion to be reproduced is cut out of some opaque material, and an arrangement made whereby a spot of light falling on a photo-cell produces the appropriate rectifying motion to enable the light to follow the edge of the plot, and as a consequence the motion of the table to follow that of the original earthquake. Description and diagram are given. C. A. S.

See also Abstract 5477.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

5493. Secular Magnetic Changes in Austria. R. Schwinner. *Gerlands Beitr. z. Geophys.* 48. 4. *pp.* 388–416, 1936.—By plotting lines of same variation on a geological map, it is shown that there is a dependence of magnetic secular variation on the major features of geological structure. W. A. R.

5494. Magnetic Perturbations. M. Bossolasco. *Comptes Rendus,* 203. *pp.* 676–678, *Oct.* 12, 1936.—The magnetic storm of April 30th, 1933, is investigated. The two points considered specially are (1) the vector which defines the initial " impetus " of a magnetic storm and (2) special perturbations called " Bay-Störungen." An examination of the intensities of the impetus recorded at stations all over the globe shows that the maximum is found at the station nearest the sun's meridian at the time of onset of the storm. The effects at stations on opposite sides of the globe are considered. The development of the impetus is seen to be more rapid in high latitudes than in equatorial regions. From the analysis of the special perturbations the author concludes that the essential character of these remains the same, both in a storm and on quiet days: also that the propagation of Bay-Störungen on the globe ought to be regarded as entirely independent of longitude. A. E. M. G.

5495. Direction of Permanent Magnetisation of Rocks. E. Thellier. *Comptes Rendus,* 203. *pp.* 743–744, *Oct.* 19, 1936.—The method used consists in the preparation in the field of soft plates attached to the rock sample and on them are marked the bearings with the help of a theodolite some hundred metres distant. The rock sample is detached and with the help of the three soft plates at right angles to one another, the inclination and declination are measured in the laboratory later. R. S. R.

RADIOACTIVITY.

5496. Geologic Time and Isotopic Constitution of Radiogenic Lead. J. L. Rose and R. K. Stranathan. *Phys. Rev.* 50. *pp.* 792–796, *Nov.* 1, 1936.—The isotopic constitutions of samples of lead from Colorado carnotite, Wilberforce uraninite, and Katanga and Great Bear Lake pitchblendes are found from densitometer measurements of the hyperfine structure of λ5372. The probable geologic ages of these minerals calculated from the Ac D : Ra G ratios agree very well with the ages from Pb : U ratios with the exception of the Great Bear Lake pitchblende in which case leaching or some other method of alteration may have changed the Pb : U ratio. [See also Abstract 3397 (1936).] AUTHORS.

5497. Range of α-Particles and Chemical Combination. M. Förster. *Ann. d. Physik,* 27. 4. *pp.* 373–388, *Oct.,* 1936.—With a view to obtaining information on the structure of a molecule the range of α-particles (from Po and from Rn) has been determined under similar conditions, at about 70°, in detonating gas under average pressure of 12·3 cm. Hg and in the H_2O vapour resulting from its explosion. The range in the vapour is about 3 % more than that in the $2H_2 + O_2$ mixture, showing that the stopping power of the vapour is about 3 % less than that calculated additively. It is then deduced that an α-particle yields 0·9 V less energy to an H_2O molecule than to its equivalent of $2H_2 + O_2$.
C. A. S.

5498. Production of Hydrogen Peroxide in Water by α-Rays. C. E. Nurnberger. *J. Chem. Phys.* 4. *pp.* 697–702, *Nov.,* 1936.—The u.v. absorption spectrum of air-free water irradiated with α-rays has been photographed between 2200 and 2800 Å. The spectrum appears to belong to a dilute aqueous solution of H_2O_2. The gases evolved from the irradiated water contain H_2 in excess of an electrolytic mixture. The parallel variation of excess H_2 pressure and H_2O absorption is consistent with Duane and Scheuer's hypothesis. Apparatus has been developed in which excess H_2 and H_2O absorption can be measured simultaneously at different times without disrupting the normal course of an experiment. The method is applicable to other radio and photochemical reactions.
AUTHOR.

5499. Fermi Theory of β-Decay. W. G. Pollard. *Phil. Mag.* 22. *pp.* 904–920, *Nov.,* 1936. *Supplement.*—The probability of β-disintegrations as given by the Fermi theory is derived for the forbidden and also for the permissible transitions. Two of Fermi's approximations are improved and the results are applied to the calculations. It is found that a function of the maximum energy and the decay constant, which theory indicates as a constant, has widely different values for the two transition types. Two methods of eliminating this difference are outlined, either of which gives fair agreement over the nine bodies considered by Fermi. A comparison is made between the momentum distributions for simple type β-ray spectra, as calculated from the improved formulæ, and the experimental H-curves. The permissible transition group agree fairly well, but in the forbidden group, in which experimental data are limited, the agreement is poor; it can, however, be improved by using the Uhlenbeck and Konopinski type of interaction. G. O. B.

5500. Liberation of Electrons by Hard γ-Rays from Solid Substances. T. G. Kujumzelis. *Zeits. f. Physik*, 102. 11–12. *pp.* 762–767, 1936.—Measurements were made with a thin-walled counting tube of the liberation of secondary electrons by means of hard γ-rays. As source of the rays the following were used: ThC″, Be + Po, and Fe + *n*. The observations were carried out in the backward and forward directions in graphite, Al, Cu, Sn, Pb. Depending on the atomic number characteristic curves are got for the outgoing radiation (forwards) which depend on the quantum energy and can be qualitatively explained by the summation action of Compton effect, photo-emission, and pair formation. The sources of the rays had quantum energies between 2·6 and 7·7 eMV. Inversely it is possible to deduce the quantum energy. The entrance radiation (backwards) rises with the atomic number corresponding with the increasing back diffusion: the course, however, depends but little on the quantum energy. J. J. S.

5501. Effect of a Magnetic Field on the Luminous Radiations Produced by the Passage of γ-Rays through Liquids. P. A. Čerenkov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 9. *pp.* 413–416, 1936. *In German.*—Using a magnetic field of 9500 gauss in a volume of 31 cm.^{3} and acting in a direction perpendicular to the surface of a liquid, it was found that little change in the intensity of induced luminosity occurred when the γ-rays were directed along the lines of force but a large increase or decrease occurred when the rays were incident transversely from left or right respectively. H_2O, C_5H_{12}, CCl_4, C_6H_6, CS_2, and other liquids all showed similar behaviour. Further experiments were made on the change in polarisation; all the phenomena receive satisfactory explanation in terms of the behaviour of Compton electrons in a magnetic field. F. C. C.

5502. γ-Radiation of the UX Complex. G. J. Sizoo and D. J. Coumou. *Physica*, 3. *pp.* 921–935, *Nov.*, 1936. *In English.*—The absorption curves (I) of the γ-radiation of this complex in Al, Cu, Sn and Pb were determined and plotted against thicknesses up to 27·4, 87·0, 65·2, and 104·4 gm./cm.^{2} respectively. Also the total absorption coefficients [see Abstract 3822 (1935)] for the same metals were plotted against λ for $\lambda < 40$ XU. Analysis of the curves I gave different results for each metal as regards the component rays, save that the wave-length of the hardest component in all lay between 7·0 and 7·6 XU. It is concluded that the γ-radiation of the UX complex has a continuous spectrum and is at least partially to be explained as an inner deceleration radiation due to loss of energy by the primary β-rays in the atom itself. C. A. S.

5503. Radioactive Haloes in Striegau Fluorite. H. Haberlandt. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 5. *pp.* 341–345, 1936.—Detailed descriptions are given of radioactive haloes occurring in fluorite octahedra in pegmatite at Striegau (Silesia). They belong to the U series, but show certain peculiarities, being confined to definite layers of the crystal and showing varying degrees of discoloration, whence, assuming equality in age of the original formation, some idea of the distribution of the original radioactive material is deducible. Irradiation of the halo-containing layer with α-rays from Po produces a characteristic colour change in the haloes, as also does cautious heating. C. A. S.

See also Abstracts 5341, 5654, 5655, 5656, 5657, 5658, 5659, 5660.

RADIATION.

ABSORPTION AND TRANSMISSION

5504. Optical Constants of Thin Silver Foil. F. Goos. *Zeits. f. Physik,* 102. 9–10. *p.* 702, 1936.—A reply to criticisms by Murmann [see Abstract 4638 (1936)]. The anomalous behaviour reported by Murmann is not exhibited by foil 40 $\mu\mu$ thick. W. R. A.

COLORIMETRY.

5505. Colour Temperature of Tungsten-Filament Lamps. D. B. Judd. *Bureau of Standards, J. of Research,* 17. *pp.* 679–695, *Nov.,* 1936.—Seasoned lamps, operated at constant voltage, gradually decrease in colour temperature because of evaporation of the filament. Since the current does not decrease enough to correspond to an appreciable change in filament temperature, this decrease in colour temperature is ascribed in large part to the accumulation of the familiar brown film on the inside surface of the bulb. The size and shape of the bulb is, therefore, important ; each type must be separately investigated. Results are given for five types. The effect of operating seasoned lamps is a gradual decrease in colour temperature, linear with time, which, like the rate of evaporation of tungsten, was found for 400-W projection lamps, to be nearly proportional to the 30th power of temperature. The effect of seasoning new lamps for 1 hr. at about rated voltage was a rise in colour temperature from 3050 to about 3140° K, approximately half of which occurred in the first 3 min. AUTHOR.

5506. Estimation of Chromaticity Differences. D. B. Judd. *Bureau of Standards, J. of Research,* 17. *pp.* 771–779, *Nov.,* 1936.—Estimation of chromaticity differences has been facilitated by the preparation of a standard mixture diagram showing by a group of ellipses the scale of perceptibility at the various parts of the diagram. The distances from the boundaries of the ellipses to their respective " centres " all correspond approximately to the same number (100) of " least perceptible differences." The estimation of nearest colour temperature has been facilitated by the preparation of a mixture diagram on which is shown a family of straight lines intersecting the Planckian locus ; each straight line corresponds approximately to the locus of points representing stimuli of chromaticity more closely resembling that of the Planckian radiator at the intersection than that of any other Planckian radiator. AUTHOR.

See also Abstract 5483.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

5507. Electric Birefringence of a Liquid Mixture. A. Goldet. *Comptes Rendus,* 203. *pp.* 716–718, *Oct.* 19, 1936.—The thermal variation of the Kerr effect has been studied for a mixture of nitrobenzene and heptane in the neighbourhood of the critical point of miscibility. The apparatus used was that previously employed for measurements of the magnetic effect and heptane was chosen in place of hexane as it was possible to obtain it pure. The birefringence increases rapidly in the neighbourhood of the critical temperature. F. S.

5508. Faraday Effect of Strong Electrolytes in Aqueous Solutions. Part V. LiCl, NaCl, KCl, LiI, NaI and KI. A. Okazaki. *Ryojun Coll. Eng., Mem.* 9. *pp.* 101–118, *Aug.*, 1936.—The relation between the magneto-optical rotation and the concentration of the aqueous solutions of the chlorides and iodides of Li, Na and K is studied for the D-lines. It is found that the " corrected " molecular rotation $M(D_2)$ of these salts decreases with increasing concentration. On the assumption that these electrolytes in solution have only one absorption band in the ultra-violet, the decrease of $M(D_2)$ with increasing concentration is attributed to the existence of undissociated molecules in concentrated solutions. The value $M(D_2)$ in the completely dissociated state is determined by graphical extrapolation to infinite dilution. Using this value and the corresponding molecular refractivity, R_2, the number of dispersion electrons in the molecules and the values of the absorption bands of these salts in the completely dissociated state are calculated. The values of e/m for the dispersion electrons of these electrolytes, together with those of the corresponding bromides, in the completely dissociated state are evaluated by using the magneto-optical rotation for the D-lines and the ordinary dispersion data. The $M(D_2)$ values of these electrolytes in the completely dissociated state are found to be given by the sum of the rotations due to the two component ions. [For Part IV see Abstract 4130 (1936).] AUTHOR.

5509. Magnetic Rotatory Polarisation and Birefringence of Solutions. J. Rabinovitch. *Comptes Rendus*, 203. *pp.* 718–720, *Oct.* 19, 1936.—Solutions of nitronaphthalene-*α* in acetone and nitrobenzene are studied using large electromagnets and a mercury lamp as source. The solvent does not affect the magnetic rotatory power, but has an influence on the birefringence. F. S.

5510. Magneto-Optical Dispersion of Formic Acid, Methyl Formate, and Isopropyl Formate. Beryl P. M. Walters and E. J. Evans. *Phil. Mag.* 22. *pp.* 816–832, *Nov.*, 1936.—Values of the refractive index n and Verdet's constant δ are determined for the highly purified liquids over a range of wave-lengths, and these are used to calculate the constants of the magneto-optical dispersion equation. This equation is then used to calculate δ, and results are compared with experiment. The magneto-optical dispersion of each liquid can be explained by the presence of a single absorption band of wave-length λ_1 in the Schumann-Lyman region, and can be represented by the equation $n\delta = K\lambda^2/(\lambda^2-\lambda_1^2)^2$. The ordinary dispersion can be represented by the equation $n^2-1 = b_0 + b_1/(\lambda^2-\lambda_1^2)$. The values of b_0 and b_1 are found from two values of n corresponding to two known values of λ, and hence n is calculated for each liquid. Finally, e/m is calculated from $e/m=2Kc^2/b_1$. N. M. B.

***5511. Photography of Minima in the Magneto-Optic Apparatus. G. Hughes.** *Am. Chem. Soc., J.* 58. *pp.* 1924–1932, *Oct.*, 1936.—A photographic method is developed to demonstrate the reality of minima in the magneto-optic apparatus. Microphotometer measurements of the difference in density of exposures taken on and off the positions of minima are attributed to variations in light intensity due to minima. The slight excess of the photographed effect over the experimental error necessitated a statistical study of the 2300 pictures taken in this investigation. This study shows only that the photographed effect is obscured by a background of changing light intensity. The measured change in intensity for a minimum was 0·7 %. Water blanks showed approximately zero percentage change. The presence of foreign materials does not change the magnitude of the intensity change for a minimum. The direction of the effect is found to be dependent on the direction of the magnetic field in the coils. AUTHOR.

See also Abstracts 5349, 5501.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

5512. Fluorescence of Rare Earths in Glasses. O. Deutschbein. *Zeits. f. Physik,* 102. 11–12. *pp.* 772–780, 1936.—Reference is made to a paper by Prosad, Bhattacharya and Chatterjee on the optical peculiarities of didymium glass [see Abstract 671 (1936)]. which is criticised as liable to give a false view of fluorescence phenomena in the rare earths. The author has investigated the fluorescence spectra and the distribution of excitation of glasses which are activated with rare earths as pure as possible. The spectra are quite analogous to the spectra of phosphors of extraneous matter and to the fluorescence spectra of pure compounds of the rare earths concerned. They are excited by light of the wave-lengths of the collective absorption bands of the relative rare earths, so far as they are of shorter wave-length than the emitted light. Selective arrangements were not observed. The emission and absorption bands are to be ascribed to various elements. J. J. S.

5513. Influence of Molecular Rotation on Fluorescent Decay. W. Kessel. *Zeits. f. Physik,* 103. 1–2. *pp.* 125–132, 1936.—The methods and results of a more thorough test than that carried out by Szymsnowski [see Abstract 3834 (1935)] of the Jablonski theory of the effect of rotation on decay time. The results are in good accord with the theory. J. E.

5514. Fluorescence Efficiency and Duration. S. I. Wawilow. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 271–276, 1936. *In German.*—Points out the difficulties of definitions and measurements of fluorescent efficiency owing to polarisation. The efficiency factor may vary between 1 and 0. The causes of quenching are many, but may be grouped under two heads: (1) The absorbed energy may be used for ionisation or dissociation or distributed as vibration-rotation energy. This kind of loss is called quenching of the first kind. (2) The excited molecule may react chemically before emission or may experience collisions of the second kind. This loss of fluorescence is known as quenching of the second kind. It is shown that assuming independence of the two kinds of quenching if $1 - s$ is the part of the absorbed energy used for quenching of the first kind, then the efficiency is related to the mean life of the excited state by $p = s.\ t/t_0$, where t is the actual life and t_0 the life in absence of quenching. This equation may be used to distinguish experimentally between the two kinds of quenching in a given case if the values of s, t and t_0 can be measured. Krawez has shown that the mean life of the excited state is inversely proportional to the integral of the absorption band. It is affirmed that in the case of fluorescing molecules in solution, where the absorption band alters its position with concentration, t must be constant, but where the area of the curve alters with concentration without a spectral shift one must assume a decrease of the excitable molecules. If with changing conditions p/t is constant then quenching of the first kind is absent or constant. J. E.

5515. Quenching of Fluorescence by Solvent. S. I. Wawilow. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3.6. *pp.* 277–284, 1936. *In German.*—It is shown that it follows from the Lewshin-Perrin theory of polarisation of fluorescence that $1/p = 1/p_0 + (1/p_0 - 1/3)\tau_1 \cdot \rho/\rho_1 \cdot s/s_1 \cdot \mathrm{R.T}/\mathrm{V}\eta$, where p and p_0 are the actual and limiting polarisations, τ_1 is the mean life of excited molecules at some arbitrary temperature, ρ_1 and ρ are the fluorescent outputs at the arbitrary temperature and the actual temperature T, s_1 and s are the effective absorbed energy at the two temperatures, V the molecular volume and η the viscosity of the solution. It is further shown that if only quenching of the second kind is present then $1/p$ is a linear function of $\rho/\rho_1 \cdot \mathrm{T}/\eta$, while if quenching of the first and second kind are both absent T is constant and $1/p$ is a linear function of T/η, whose proportionality factor gives τ. Results are given for rhodamine B in glycerin showing a linear relation between $1/p$ and $\rho/\rho_1 \cdot \mathrm{T}/\eta$. This can only be accounted for by the quenching action of the solvent. Results for rhodamine in isoamyl alcohol and isobutyl alcohol show that in these cases while τ is constant s is not, which means that quenching of the first kind is present but quenching of the second kind absent. The results altogether are taken to indicate interaction between the solvent and the fluorescent molecules, either in the excited state (quenching of second kind) or in unexcited state (quenching of first kind producing changes of absorption). The form of interaction occurring depends on the nature of the solvent. J. E.

5516. Luminescence of Calcite. Part I. E. Iwase and T. Kuronuma. Parts II and III. E. Iwase. *Chem. Soc. Japan, Bull.* 11. *pp.* 513–538, *Aug.*, 1936. *In German.*—In Part I the photoluminescence of calcites from many different places in Japan shows spectra with band maxima at 625–635, 460–470, 515–520 and 560–570 $\mu\mu$. Photometer curves are given. In Part II the thermoluminescence (natural and X-ray excited) is studied. Broad bands with few signs of structure are found. In Part III the effect of heating is investigated. The white fluorescent material shows an increase of brightness after heating, the increase rising to a maximum. The orange fluorescence is not affected by previous heating. The white fluorescence shows after considerable heating a number of narrow bands which are accounted for by the presence of rare earths. J. E.

INTERFERENCE. DIFFRACTION AND SCATTERING.

5517. Interferometer Method of Determining Strain. F. Tank. *Helv. Phys. Acta*, 9. 7. *pp.* 611–616, 1936. *In German.*—A method described by Favre for measuring absolute phase differences with a 4-plate interferometer is analysed and a simple extension of it is suggested. A model is brought into the ray path, at a point O, of a beam plane-polarised in a vertical plane. The strain at O may then be completely analysed by measuring (*a*) the inclination of the principal strain directions with respect to the vertical, (*b*) the difference $(\sigma_1 - \sigma_2)$ and (*c*) the sum $(\sigma_1 + \sigma_2)$ of the principal strains. A description is given of the mode of carrying out these measurements. H. J. H. S.

5518. Interferometer Analysis of Heavy Water. N. S. Filippowa and M. M. Sluckaia. *Acta Physicochimica*, 5. 1. *pp.* 131–136, 1936. *In German.*—Reference is made first to the difficulties encountered and the accuracy obtained by Luten and others in these measurements. The authors obtained a step curve for interferometer measurements for the range of the compensator and employed more than one vessel. The density and interferometer methods show good agreement for weak concentration while for greater concentrations the agreement is within 0·5 %. The temperature coefficient for the refractive index over the range 18° — 25° C. is found for a series of solutions and good agreement occurs with the results obtained by other experimenters. R. S. R.

5519. Theory of Diffraction at a Distance. J. Savornin. *J. de Physique et le Radium*, 7. *pp.* 434–440, *Oct.*, 1936.—The diffraction of light by a narrow wedge of metal is studied, taking into account the optical properties of the metal. The incident light is plane polarised at 45° to the edge of the wedge. The diffracted light is elliptically polarised. The direction of the major axis and the eccentricity of the polarisation ellipse are found. When these quantities are expressed as functions of the incident wave-length, of the deviation of the diffracted ray or of the angle of incidence, the effect of the optical properties of the wedge on the diffracted light is particularly clearly revealed. G. C. McV.

5520. Measurement of Scattered Light in Disperse Systems. B. Klages and H. Klumb. *Phys. Zeits.* 37. *pp.* 724–726, *Oct.* 15, 1936.—A method of measuring the light scattered in media with small turbidities is described, in which the medium is contained in a cylindrical cell and illuminated through the plane ends, whilst the scattered light is measured in a photo-cell arranged as an outer vessel enclosing the curved surface. The apparatus has been tested with considerable success on various liquid and gaseous media, and it was found that it could be used for measurements of changes of concentration through sedimentation and coagulation, and for following chemical reactions. The limiting concentrations measured were 10 to 100 mg./m.^{3} in aerosols and 1 to 10 mg./l. in hydrosols. C. B. A.

See also Abstracts 5347, 5378, 5542, 5551, 5568, 5621, 5625, 5627, 5629, 5630.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

5521. Photochemical Reactions in Monolayers. J. S. Mitchell. *J. Chem. Phys.* 4. *pp.* 725–730, *Nov.*, 1936.—The molecular orientation dependence theory of the velocity of photochemical reactions in monolayers at the surface of aqueous substrates is developed. The molecular extinction coefficient in the film is discussed and " apparent quantum efficiency " is defined. It is pointed out that the absorption spectrum of a monolayer has to be directly measured for the absolute determination of the quantum efficiency of a photochemical reaction. J. K.

5522. Effect of Light on the Ignition of Monosilane-Oxygen Mixtures. H. J. Emeléus and K. Stewart. *Faraday Soc., Trans.* 32. *pp.* 1577–1583, *Nov.*, 1936.—Monosilane, disilane, and trisilane absorb light of wave-lengths < 1850, < 1980–2020, < 2140–2190 Å respectively. Monosilane mixed with Hg vapour is decomposed by the 2537 Å Hg resonance line, giving H_2 and a solid reaction product consisting of a polymerised hydride SiH_x ($x < 0{\cdot}9$) or a mixture of Si and such a polymer. Monosilane-O_2 mixtures at temperatures below the normal range for thermal ignition may be caused to explode by irradiation with light from an Al spark or a Hg resonance arc. Monosilane-O_2 mixtures at pressures above the critical explosion pressure undergo a slow oxidation on exposure to the unfiltered light from a Hg resonance arc. This reaction has an induction period, and in its initial stages follows the exponential law $\Delta p = ke^{\varphi t}$ which characterises hydrocarbon combustion. AUTHORS.

5523. Photographic Latent Image from Standpoint of Quantum Mechanics Model of Crystals. J. H. Webb. *Kodak Research Lab., Comm. No.* 598. *J.O.S.A.* 26. *pp.* 367–383, *Oct.*, 1936.—A detailed examination is made of some of the known properties of the photographic latent image with particular reference to the quantum mechanics picture of crystals, a one-dimensional picture being employed. The properties considered are (1) band absorption and spectral sensitivity of AgBr, (2) photoconductivity of AgBr, (3) absorption band of the photographic latent image in AgBr, (4) the part played by impurities, (5) reversal phenomena in the latent image, and (6) reciprocity law failure. No essentially new results are given, but it is shown how the known facts fit in with the new picture given for ionic crystals on the basis of quantum mechanics. A. H.

5524. Low-Intensity Solarisation. H. P. Griggs. *J.O.S.A.* 26. *pp.* 384–385, *Oct.*, 1936.—Earlier experiments are extended and reversals of an order higher than the second are found for 3 emulsions in addition to that in which it was originally found. A. H.

5525. Berthon-Siemens Colour Film. P. Storch. *Siemens Zeits.* 16. *pp.* 329–334, *Sept.*, 1936.—Briefly describes the construction, operation and technical procedure used in the manufacture of this colour film, and in obtaining copies. The film consists of serrations across the back which act as cylindrical lenses, the radius of curvature being 0·032 mm. and the thickness only 0·004 mm. A three-colour filter is placed in the objective lens system so that the finished picture consists of a very large number of narrow black and transparent lines across the film, a similar three-colour filter being necessary for reproduction in colour. R. C. F.

See also Abstract 5498.

PHOTOMETRY.

***5526. Photovoltaic Cell Reflection Densitometer. Nora M. Mohler and Delia A. Taylor.** *J.O.S.A.* 26. *pp.* 386–387, *Oct.*, 1936.—A simple densitometer is described, usable either as a reflection or a transmission instrument. The detecting device is a Westinghouse Photox cell, which possesses advantages in that (1) it requires no external voltage supply, (2) its colour sensitivity curve agrees well with that of the eye, therefore no filters are required, and (3) its response to illumination is linear, hence no calibration curve is required. The results obtained are reproducible to within 1 % and the densities determined by it agree well with those determined by other methods. A. H.

***5527. Contouring Density Comparator. J. M. Waldram.** *Journ. Sci. Instruments.* 13. *pp.* 352–357, *Nov.*, 1936.—A comparator is described for use in connection with the photographic photometry of brightness distributions, whereby contours of equal brightness can be drawn directly from a suitable photographic plate. AUTHOR.

5528. Measurement of Non-Uniform Brightness by Photographic Photometry. A. Bloch. *Journ. Sci. Instruments,* 13. *pp.* 358–364, *Nov.*, 1936.—Some precautions are indicated which have to be observed when the field investigated is not uniform, but is composed of a large number of small elements of varying brightness. The photographic plate will give a correct arithmetic mean value only when its transmission is (over the necessary range) linearly dependent on the original brightness values, which makes it necessary, in principle, to carry out measurements on a positive transparency in which $\gamma = 1$. Erroneous readings, varying with the length of exposure, will occur when the elements are not rendered on the straight line part of the characteristic. If the size of the single elements is small, the influence of secondary effects (developer, turbidity, gelatin-effect) has to be considered. Formation of mean values simultaneously with the first exposure (*e.g.*, by reducing the resolving power of the objective) is then preferable, and may then eliminate the necessity of making a positive print. AUTHOR.

5529. Elimination of Errors Due to Stray Light in Spectrophotometry. J. S. Preston. *Journ. Sci. Instruments*, 13. *pp*. 368–370, *Nov.*, 1936.—This note describes a method of eliminating the errors which may arise in spectrophotometric measurements through the presence of stray light in the exit slit of the monochromator. The method is primarily applicable to direct photoelectric observations, and dispenses with the usual stray light filter. AUTHOR.

See also Abstracts **5460, 5462, 5532, 5550, 5629.**

POLARISATION.

5530. Optical Investigation of Indian Oils. Part I. Depolarisation of Scattered Light. C. V. Jogarao. *Indian Acad. Sci., Proc.* 4*A*. *pp*. 327–331, *Sept.*, 1936.—The degree of polarisation of the light scattered transversely from a number of purified vegetable oils, illuminated by plane polarised or by unpolarised light, is examined. Complete depolarisation is found in the transversely scattered light; hence, following Krishnan, the oils contain no large molecular aggregates. Contrary to Krishnan's findings, pure formic and acetic acids also show complete depolarisation. L. V. C.

5531. Rotatory Dispersion of Bridged Derivatives of Alkyltartrates. Y. Tsuzuki. *Chem. Soc. Japan, Bull.* 11. *pp*. 586–592, *Sept.*, 1936.—Rotatory dispersions in the region from 6708 Å to 4358 Å of diethyl and dimethyl isopropylidene-tartrates, diethyl and dimethyl ethylidene-tartrates and diethyl methylene-tartrate, bridged derivatives of alkyl-tartrates, in which both the hydroxyls are linked with the rest of the carbonyl compounds have been measured, all with no solvent, and shown to be expressed by one term of Drude's equation. It is pointed out that the absorption bands of the condensation products from ketone are located at about 1750 Å, whereas those of the compounds derived from aldehydes at about 2100 Å, and the relation between these values and the chemical constitution is discussed. Considering the fact that the dispersion ratio a_{4358}/a_{5461} and the characteristic wave-length λ_0 range from 1·674 to 1·748 and from 1735 Å to 2141 Å respectively, the rotatory dispersion of these compounds is concluded to be very probably simple. AUTHOR.

***5532. Barrier-Layer Photoelectric Cell in Photoelectric Photometry. A. W. Smith, H. Newhouse and P. Drake.** *Rev. Sci. Instruments*, 7. *pp*. 433–434, *Nov.*, 1936.—When the barrier-layer photoelectric cell is used in measuring the intensity of polarised light, errors may arise which depend upon the direction of the electric vector with respect to the plane of incidence. Curves are given which show that these errors may amount to as much as 30 %. AUTHORS.

See also Abstracts **5549, 5562.**

RADIATION, EMISSION.

5533. Characteristics of Mercury-Rare Gas-Discharge Tubes. H. W. Melville. *Faraday Soc., Trans.* 32. *pp.* 1525–1531, *Nov.*, 1936.—Some characteristics of Hg-rare gas-discharge tubes are measured in order to find optimum conditions for the running of a tube capable of dealing with an input of 400 W and emitting the resonance line at 2537 Å. For an input of 70 W it is found possible to obtain an output of 10^{19} quanta per sec. At least 90 % of the total radiation is at 2537 Å. The optimum conditions occur at about the same values as those for the production of metastable inert gas atoms. Suggestions are made as to the mechanism of the collision processes taking place in the lamp on these bases. AUTHOR.

5534. Residual Current of Ionisation Chambers and Pressure Dependence of Ionisation by Penetrating Radiation. W. Messerschmidt. *Zeits. f. Physik*, 103. 1–2. *pp.* 18–26, 1936.—Using an ionisation chamber of 24·5 l. capacity, the ionisation due to penetrating radiation is examined down a mine at a depth of 870 m. Continuous registration over a period of 274 hr. failed to show a single Hoffmann collision. F. C. C.

5535. Cosmic-Ray Bursts. W. Messerschmidt. *Zeits. f. Physik*, 103. 1–2. *pp.* 27–56, 1936.—Two ionisation chambers, 24·5 l. in volume and filled with air at 26 atm., were used to determine the frequency distribution of the bursts with size for Al, Fe and Pb. The size of the bursts corresponding to the maximum frequency increases with atomic weight, and is independent of the thickness of the material. For Pb this frequency decreases for thicknesses above 5 cm., but for Al it increases up to 30 cm. For a composite screen of two elements, the maximum corresponding to each element appears. Observations taken with a double chamber, containing a screen between the two compartments, show that the range of the electrons constituting a burst is 5 cm. in Pb. The variation of the frequency of the bursts with barometric pressure was investigated, and correlated with the water content of the atmosphere. D. H. F.

5536. Absorption of Cosmic-Ray Secondaries and Showers. D. K. Froman and J. C. Stearns. *Phys. Rev.* 50. *pp.* 787–789, *Nov.* 1, 1936.—A triple tube counter system is used with the three counters in a vertical line to measure the absorption by Pb of single secondary and shower rays produced in Pb and emerging in a small solid angle. The apparent absorption coefficient obtained is $0 \cdot 82 \pm 0 \cdot 18$ cm^{-1} Pb. It is found (*a*) that the optimum thickness of Pb scattering block for shower production is not a function of the amount of absorbing material placed above a lower counter. (*b*) that the penetrating power of the shower particles is independent of the thickness of the scatterer from 0 to 3 cm. of Pb. With *triangular* arrangement of the counters the absorption coefficient for shower particles produced in Al is equivalent to $0 \cdot 49$ cm^{-1} Pb which is of the same order of magnitude as that for Pb showers with the same arrangement. F. C. C.

***5537. Apparatus for Transmitting Cosmic-Ray Data from the Stratosphere. R. L. Doan.** *Rev. Sci. Instruments*, 7. *pp.* 400–406, *Nov.*, 1936.—A relatively economical method for obtaining cosmic-ray data from the stratosphere is devised by making use of a small radio transmitter to communicate from a free unmanned balloon to a ground station where a continuous record is obtained during the flight. Cosmic-ray intensity is measured with a thin steel ionisation chamber of 20 l. capacity filledwith A at 5 atm. and connected to a Dersham electrometer.

A neon tube flasher is used as signal generator, the flash frequency being made to depend on atmospheric pressure by magnified motions of a sylphon bellows, thus serving as a signalling barometer. The recovery of the apparatus presents difficulties, one specimen coming down 175 miles from its starting point. F. C. C.

See also Abstract 5660.

RADIATION, GENERAL THEORY.

5538. Dissociative Equilibrium and Pair Generation. J. Kishen. *Indian Journ. Phys.* 10. *pp.* 389–397, *Sept.*, 1936.—A general formula for the dissociative equilibrium in an external radiation field is developed. This formula is applied to the phenomenon of thermal ionisation, and Saha's equation and other allied relations are obtained. It is further applied to the formation and annihilation of pairs of electrons and positrons existing in statistical equilibrium with radiation and the consequences are discussed. AUTHOR.

5539. Photons and Particles of Pure Charge. A. Proca. *Comptes Rendus*, 203. *pp.* 709–711, *Oct.* 19, 1936.—The author points out that one consequence of his quantum theory of generalised particles is to predict the existence of a particle with charge and no mass which is not a neutrino, in fact a pure charge. G. C. McV.

5540. Structure of the Photon. T. V. Ionescu. *Comptes Rendus*, 203. *pp.* 864–867, *Nov.* 3, 1936.—A theory of the photon is put forward based on that previously given for the electron [see Abstract 5276 (1936)]. The electron is regarded as an annulus of electric charge which rolls without slipping. It is supposed that the photon is formed of two masses in the form of annuli with equal and opposite charges. They have the same properties as the electron; they roll without slipping during a displacement, and they have a mechanical moment equal to that found for an electron when it passes from the $(n + 1)$th orbit to the nth. They have also a magnetic moment equal to the variation of the moment of the atom. These two electric particles, referred to as photonic particles, are coupled electrically and magnetically to form a photon. The energy of translation, mechanical moment and electrical moment of the photon are calculated. The experimental fact that under certain conditions a photon can be decomposed into two electrons, one positively charged and the other negatively charged, is explained by the theory. C. J. B. C.

5541. Invariant Perturbation Theory of the Electron-Neutrino Particles under the Influence of an Electromagnetic Field and a Central Force. E. C. G. Stueckelberg. *Helv. Phys. Acta*, 9. 7. *pp.* 533–554, 1936. *In German.*—The author develops his theory that electrons and neutrinos are the same elementary particle in different quantum states. A perturbation theory for the motion of this particle in an electromagnetic field and a central field of force is worked out and applied to the recombination of the outer electrons in the K-ring with the atomic nucleus. This recombination gives rise to a neutrino radiation and a γ-radiation. G. C. McV.

See also Abstract 5425.

REFLECTION. REFRACTION AND DISPERSION.

5542. Influence of Polished Surface on Optical Constants of Copper. H. Lowery, H. Wilkinson and D. L. Smare. *Phil. Mag.* 22. *pp.* 769–789, *Nov.*, 1936.—Dispersion curves of Cu for the visible spectrum are obtained by Drude's method, using mirrors prepared (i) by evaporation, (ii) by mechanical polishing, and (iii) by an electrolytic method which produces a polished surface free from the amorphous Beilby layer. The refractive index and absorption coefficient are observed to decrease and increase respectively upon the removal of the mechanically polished surface by the electrolytic process. Progressive changes in the optical constants are studied as increasing depths of the mechanically disturbed surface are removed. The removal of the amorphous Beilby layer, which others have estimated as being 30–40 Å. in thickness, brings about a distinct change in the optical constants, but the mechanical disturbance of the surface extends beyond the Beilby layer to a depth of 0·0013 to 0·0029 cm. or more, and affects the optical constants. A previous investigation on the effect on the constants of the exposure of Cu to the atmosphere [see Abstract 4220 (1932)] is repeated with more conclusive results. AUTHORS.

5543. Equivalent Dispersion of Strong Electrolytes in Solution. Parts I, II and III. A. Kruis. *Zeits. f. phys. Chem.* 34. *Abt.B.* 1–2. *pp.* 13–81, 1936.—Part I gives a discussion of the interferometric method used and enumerates the results obtained in the visible region. The refractive index of water is determined at 25° C. for various wave-lengths with an accuracy of $0 \cdot 0_5 3$. The investigations are extended to aqueous solutions of NaCl, KCl, $SrCl_2$, NH_4NO_3 and Na_2SO_4 and the equivalent refractions and equivalent dispersions are calculated. The refractions of NaCl, KCl and $SrCl_2$ show maxima at about 1·2, 0·9 and 0·3 *N.* respectively. The equivalent dispersion varies approximately in proportion to the concentration. With increasing concentration the equivalent dispersion decreases for NaCl, KCl, $SrCl_2$ and NH_4NO_3 and increases for Na_2SO_4. In Part II the effects observed in Part I are discussed in the light of the dispersion theory. The results for the alkali chlorides lead to the conclusion that the change of dispersion with concentration is due to changes of characteristic frequency and transition probability for the long-wave u.v. band ascribed to the halide ion. The change of refraction with concentration, on the other hand, is due principally to a change of the parameters of a far u.v. band. Values of the refraction for infinitely long wave-length and the equivalent dispersion at infinite dilution are calculated and discussed. Finally an attempt is made to derive the equivalent dispersions of the individual ions, assuming additivity and a zero value for Na^+. In Part III consideration of the data of Heydweiller and co-workers upon refractive indices in the u.v. region reveals a dependence of equivalent dispersion upon concentration for a number of salts in solution. With increasing concentration the equivalent dispersion increases for Li_2SO_4, $NaClO_4$ and NH_4F, but decreases for LiCl, NaCl, CsCl, $MnCl_2$, $NiCl_2$, CH_3COOLi, LiBr, RbBr, NaI and LiCNS. There is practically no variation with concentration for $LiClO_3$ and $NaClO_3$. [See following Abstract.] L. A. W.

5544. Variation of Equivalent Refraction of Strong Electrolytes with Concentration. A. Kruis. *Zeits. f. phys. Chem.* 34. *Abt.B.* 1–2. *pp.* 82–95, 1936.—The variation of equivalent refraction with concentration below 1 *N.* deviates from that to be expected by extrapolation from the almost linear variations at greater concentration. In this theoretical paper an attempt is made to explain this as due to a lowering of the refraction of the water molecules not immediately adjacent to the ions. The effect is thought to be connected with the influence of the dissolved electrolyte upon the quasi-crystalline structure or the degree of polymerisation of the water. [See preceding Abstract]. L. A. W.

5545. Refraction in Solutions. Part V. Complete Refraction Curve of Urea. J. M. Scherschewer and A. E. Brodsky. *Zeits. f. phys. Chem.* 34. *Abt.B.* 1–2. *pp.* 145–150, 1936.—Using interferometer and refractometer methods similar to those described earlier [see Abstract 668 (1936)], the refraction curve for urea is found for concentrations between 0·003 and 4·1 *N*. For a non-electrolyte (urea) and a strong electrolyte (KCl) the curves are so similar that from these alone no conclusion can be drawn as to the condition of the electrolyte in solution; but, in contrast to this, the curves of the apparent molecular volume show characteristic differences as theory predicts. H. M. B.

5546. Refractive Index of Deuterium. W. J. C. Orr. *Faraday Soc., Trans.* 32. *pp.* 1556–1559, *Nov.*, 1936.—The difference in the refractive indices of H_2 and D_2 are determined, using a Rayleigh gas interferometer. Assuming the value 1·00013966 for H_2 at λ 5462 the refractive index of D_2 is found to be 1·0001378(7). AUTHOR.

5547. Refractivity Intercept. S. S. Kurtz, Jr., and A. L. Ward. *Frank. Inst., J.* 222. *pp.* 563–592, *Nov.*, 1936.—The significance of refractive index data and the relationship between the refractive index and the density of hydrocarbons are discussed. There are presented a new concept of refraction and a simple new constant, $n - d/2$, designated refractivity intercept, which is characteristic of each hydrocarbon series. The refractivity intercept is shown to represent a more constant relationship between the densities and refractive indices of the members of an homologous series of hydrocarbons than the usual equations for refractivity. It is also shown that Newton's specific refraction equation represents the relationship between density and refractive index for sets of hydrocarbon isomers better than the Lorentz and Lorenz, Eykman, or Gladstone and Dale equations. Finally, it is shown that the fundamental difficulty in past work on refractivity was the attempt to make one equation represent the effect of both temperature and constitution on the relationship between density and refractive index. For hydrocarbons, it is demonstrated that it is impossible for one equation to represent both the temperature and constitution effects. AUTHORS.

5548. Accuracy of Dispersion Equations for Water. L. W. Tilton. *Bureau of Standards, J. of Research*, 17. *pp.* 639–650, *Nov.*, 1936.—The technique in using the Ketteler-Helmholtz dispersion equation is discussed and the validity in representing the dispersion of water over the visible range of wave-lengths is tested by the least-squares adjustments of sixth-decimal-place refractive indices. It is concluded that four parameters are sufficient for accuracy within the spectral range investigated. AUTHOR.

5549. Stereoscopic Projection with Polarised Light. M. v. Ardenne. *Zeits. f. techn. Physik*, 17. 10. *pp.* 332–337, 1936.—After a description of the procedure for stereoscopic projection with polarised light the properties of dichromatic filters in relation to their use for large scale film projection are investigated. With the help of a specified measuring arrangement the reflection characteristics with normal and polarised light for a number of known projection screens are examined. It is shown that for a cinema of normal structure either a sufficient extra scattering angle or a sufficiently small depolarisation is given. By investigating more closely the steady reflecting surface these two conditions are united. R. S. R.

***5550. Powerful Cylindrical Lens Arrangement. W. Kinder.** *Zeits. f. Instrumentenk.* 56. *pp.* 393–404, *Oct.,* 1936.—Considers first the known cylindrical lens arrangements and then describes a powerful arrangement whereby intensity limits for photographic photometry can be obtained. Possible variations of this arrangement are also given, one of which allows of the simultaneous production of two such intensity distributions. This latter arrangement is used to determine whether the instants of closure, with different stops, give the same blackening on photographic plates, using the same illumination and after-treatment.
R. C. F.

See also Abstracts **5389, 5504, 5518, 5608, 5668.**

SPECTROSCOPY.

5551. Constancy of Wave-Length of a Spectral Line. G. C. Omer, Jr., and J. L. Lawson. *Astrophys. J.* 84. *pp.* 477–478, *Nov.,* 1936. —The Hg line λ4358 was observed with a Fabry and Perot etalon from June 24 to Aug. 27, 1935. The wave-length of this line was found to be constant to within 2 parts in 1,000,000. AUTHORS.

5552. New Terms in the Arc Spectrum of Tellurium. S. G. Krishnamurty. *Indian Journ. Phys.* 10. *pp.* 365–374, *Sept.,* 1936.—The arc spectrum of Te is investigated from λ1600 to λ5000, using an arc between Acheson graphite poles containing powdered Te metal. A quartz Littrow spectrograph and a vacuum grating spectrograph were employed for the purpose. The results obtained lead to a confirmation of McLennan's scheme, and also to the discovery of eight new odd levels in addition to those due to the 5*d* and 6*s* configuration. AUTHOR.

5553. Magnetic Interaction in the Deuteron. H. B. G. Casimir. *Physica,* 3. *pp.* 936–938, *Nov.,* 1936. *In English.*—It is shown, that the magnetic interaction between proton and neutron would give rise to an energy difference of roughly 10^5 eV between the lowest triplet state and the lowest singlet state of the deuteron, the singlet state being lowest.
AUTHOR.

5554. Test of Interval Rule in the $^2D_{3/2}$ State of Bismuth I. Esther U. Mintz. *Frank. Inst., J.* 222. *pp.* 613–623, *Nov.,* 1936.—The hyperfine structure of the line λ4722 of the arc spectrum of bismuth was investigated with a Fabry-Perot interferometer. After corrections were made for the mutual influence of the components, deviations from the Landé interval rule were observed in the $^2D_{3/2}$ state. These are accounted for by the addition of a $\cos^2$ term to the usual law of interaction.
AUTHOR.

5555. Quadrupole Moment and Magnetic Moment of $^{75}_{33}$As. H. Schüler and M. Marketu. *Zeits. f. Physik,* 102. 11–12. *pp.* 703–708, 1936.—From the hyperfine structure measurements of AsII the quadrupole moment of the As nucleus is found to be $0 \cdot 3 \times 10^{-24}$, the electric charge distribution being extended in the direction of the nuclear spin axis. From the splitting factors of two AsII and three AsIV hyperfine structure terms five values of the magnetic moment are calculated and provide an average value of $1 \cdot 5$ nuclear magnetons. J. E. K.

5556. $^3\Pi_{1u}$ State and Absorption Continuum of the Bromine Molecule. O. Darbyshire. *J. Chem. Phys.* 4. *pp.* 747–748, *Nov.,* 1936. —Bands were photographed and measured in the extreme red due to transitions from higher *v''* levels to lower *v'* levels than those already recorded. In spite of the vapour temperature being 450° C. compared to Brown's 100° C., only two new $\Delta G'(v + 1/2)$ values and three new $\Delta G''(v + 1/2)$ values were obtained. Brown's numeration has been increased by 7 units and certain constants calculated. Explanations of the absorption continuum put forward by Acton, Aitken and Bayliss, and by Franck and Condon are discussed, but found inadequate to explain all five observed maxima. F. S.

5557. Absorption Spectra of Secondary Amines in the Near Infra-Red. Marie Freymann. *Comptes Rendus*, 203. *pp.* 721–722, *Oct.* 19, 1936.—Like the primary aliphatic amines, the secondary aliphatic amines are found to possess an intense band at about 10,500 Å. (There is also another band at 10,750 Å.) The corresponding intense band for the aromatic secondary amines is very broad and situated at shorter wavelength (10,212 Å), though there is an inflection at about 10,400 Å. Pyrrol possesses a similar spectrum—a band at 10,116 Å and an inflection at about 10,413 Å. It is thought that the inflections may correspond to normal NH and the broad bands to NH perturbed by neighbouring double bonds. The spectrum of piperidine shows, in addition to an intense band at 10,478 Å corresponding to normal NH, three weaker bands. This may indicate the existence of several forms of molecule in equilibrium. L. A. W.

5558. Absorption Spectra of Alcohols and Nitric Acid. R. M. Badger and S. H. Bauer. *J. Chem. Phys.* 4. *pp.* 711–715, *Nov.*, 1936.—The absorption spectra of the vapours of 12 alcohols and of nitric acid are investigated by photographic methods in the region λλ9450–9850. In each case a strong harmonic band of the O — H vibration was found. In the primary alcohols and in *o*-chlor phenol the O — H vibration was found to split into two components, a possible explanation for which is briefly discussed. In the bands of certain other substances a considerable complexity of structure was observed which is attributed either to a free rotation or a torsional vibration of the hydroxyl hydrogen with respect to the remainder of the molecule. Systematic shifts in the frequency of O — H vibration with changes in the structure of the alcohol molecule were found. AUTHORS.

5559. Ultra-Violet Absorption Spectra of Pr^{+++} and Nd^{+++} Ions in Solution. P. C. Mukherji. *Indian Journ. Phys.* 10. *pp.* 319–324, *Sept.*, 1936.—The u.v. absorption spectra of Pr-$^{+++}$ and Nd-$^{+++}$ions in solution are investigated using chlorides and sulphates. In $Pr_2(SO_4)_3$ solution, a broad and diffuse band is observed which is resolved into three components at 2730, 2605 and 2560 Å at a suitable concentration. This band is investigated also with a Hilsch double monochromator and its origin discussed. In Nd-$^{+++}$ ion only four new lines have been observed at 2775, 2730, 2600 and 2505 Å. Working with ($NdCl_3$, $6H_2O$) crystal Freed has reported the existence of a broad and diffuse band which extends from 2280 to 2100 Å; but here no such band is observed in either of the solutions investigated. In chloride solution continuous absorption occurs in the near u.v. and this partly masks the absorption effect. AUTHOR.

5560. Absorption of Sulphur Vapour between 3600 and 5000 Å. B. Rosen and L. Neven. *Comptes Rendus*, 203. *pp.* 663–665, *Oct.* 12, 1936.—L. d'Or [see Abstract 700 (1936)] compared the intensity of the spectra at different temperatures and pressures with the percentages of S_8, S_6, and S_2, given by thermochemical considerations and concluded that the absorption is due to S_4 or perhaps S_3. This work is repeated and all the bands fitted into the S_2 system. This assignment is verified by the intensity of the bands at various pressures and high temperatures. The results of d'Or and Henri at lower temperatues may be due to an overlying continuous absorption of a polyatomic molecule. H. G. C.

5561. Ultra-Violet Absorption Spectra of Substituted Biphenyls. Lucy W. Pickett, Gertrude F. Walter and Helen France. *Am. Chem. Soc., J.* 58. *pp.* 2296–2299, *Nov.*, 1936.—Absorption curves showing molecular extinction coefficients in the region 32–46,000 $cm.^{-1}$ are given for five methyl and chloro derivatives of biphenyl and three diphenylbenzenes. The compounds with restricted rotation differ markedly in the intensity and structure of the absorption band from those capable of free rotation. AUTHORS.

5562. Ultra-Violet Absorption and Rotatory Dispersion of 3-Methylcyclohexanone. H. S. French and M. Naps. *Am. Chem. Soc., J.* 58. *pp.* 2303–2305, *Nov.*, 1936.—Tables and curves are given for the u.v. absorption and rotatory dispersion of 3-methylcyclohexanone in cyclohexane solution. These afford further evidence for the non-homogeneous nature of the carbonyl absorption band, and for the induced dissymmetry of the carbonyl group. AUTHORS.

5563. Isotope Effect in Ionised Mercury Hydride Bands (HgH^+ and HgD^+). S. Mrozowski. *Zeits. f. Physik*, 102. 7–8. *pp.* 545–547, 1936.—The author claims that conclusions drawn by Hori and Huruiti [see Abstract 4214 (1936)] about departures from the usual isotope formulæ are insufficiently well-grounded, as he thinks that their analysis of the HgD^+ bands is not precise enough to allow of their conclusions. A. C. M.

5564. Intensity of Rotation Lines and Excitation Conditions. H. Brinkman. *Phys. Zeits.* 37. *pp.* 726–728, *Oct.* 15, 1936.—Hermann's earlier work [see Abstract 1684 (1936)] is repeated as it is found that the change in rotation-energy is not to be understood by consideration of mechanism of excitation of the various rotation-states, and his results are attributed to errors of measurement. The various rotation-lines of a band have the same absolute emission. **O. Herrmann,** *ibid*, p. 729, comments upon certain differences in conditions of experiment and acknowledges that the term " absolute emission " in Table II of his original paper is unfortunate. F. S.

5565. 2s $^1\Sigma \rightarrow$ 2p $^1\Sigma$ Bands of the Hydrogen Molecule. G. H. Dieke. *Phys. Rev.* 50. *pp.* 797–805, *Nov.* 1, 1936.—The so-called $^1X \rightarrow 2p\,^1\Sigma$ bands of H_2 have been considerably extended and the analogous systems of HD and D_2 discovered. The discovery of the new bands shows that the properties of the upper level of these bands are considerably different from those assumed until now, and the new facts allow a quite unambiguous identification of this level as $2s\ ^1\Sigma$. This state has an equilibrium distance of $1{\cdot}0087 \times 10^{-8}$ cm. slightly greater than the corresponding triplet level and is slightly less firmly bound. For the estimate of the significance and accuracy of the various constants the comparison of the three isotopic molecules is of great help. The $2s\ ^1\Sigma$ state shows marked class *B* perturbations and the perturbing state is very probably $(2p\ \sigma)^2\,^1\Sigma$ which should lie roughly 3500 cm^{-1} above $2s\ ^1\Sigma$. This would explain also the fact that the $2s\ ^3\Sigma$ states does not show any perturbations. AUTHOR.

5566. Absorption of Resonance Radiation by Sodium Atoms. J. L. Tuck and E. Warhurst. *Faraday Soc., Trans.* 32. *pp.* 1501–1503, *Oct.*, 1936.—Variation of absorption with temperature at constant atom density is investigated with the apparatus of Fairbrother and Tuck [see Abstract 2164 (1936)] except for an alteration to the absorption cell. On plotting the percentage absorption against temperature it is found that the absorption of a constant number of mols decreases linearly with temperature between 140° and 320°. Approximate corrections of reaction velocity constants from previous absorption curves are given. W. R. A.

5567. Stark Effect on α-Diagonal Bands of HD and D_2. H. Hasunuma. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 469–489, *Sept.*, 1936.—The Stark effect on the α-diagonal bands of HD and D_2 is observed with a spectrograph of 10·7 Å/mm. dispersion. The field-strength ranged from 100 to 210 kV/cm. The comparison of the effects in three molecules H_2, HD and D_2 shows that they occur roughly with the same magnitudes but there is no corresponding similarity among them. This may be theoretically expected. AUTHOR.

5568. Wings and Rayleigh Lines in Liquid Mixtures. Part II. S. C. Sirkar and B. K. Mookerjee. *Indian Journ. Phys.* 10. *pp.* 375–387, *Sept.*, 1936.—The distribution of intensity in the wing accompanying the Rayleigh line due to carbon disulphide, chloroform, chlorobenzene, acetone, xylene and dilute solutions of these substances in methyl alcohol is investigated by photographic photometry. The distribution of intensity observed in the case of each of the solutions is compared with that due to the corresponding pure liquid. It is found that except in the case of chlorobenzene, the relative intensity of the wing with respect to that of any particular vibrational Raman line increases appreciably in all other cases on dissolving the pure liquid in methyl alcohol, and in the case of chlorobenzene, it remains practically unchanged. In none of these liquids, however, is there any marked diminution in the intensity of any portion of the wing with the dissolution of the liquid in methyl alcohol. This fact and the other results are discussed in the light of the theories put forward previously by various authors in order to explain the origin of the wing. [See Abstract 1719 (1936).] AUTHORS.

5569. Raman Effect of Sesquichamene and other Terpenes. K. Matsuno and K. Han. *Chem. Soc. Japan, Bull.* 11. *pp.* 576–586, *Sept.*, 1936.—The Raman spectra of the following substances are measured: sesquichamene. *d*-sabinene, *d*-α-pinene, *d*-verbenol, *d,l*-Δ^1-terpinenol-(4), menthyl acetate, and isobornyl acetate. The occurrence of the intense line at $\Delta\nu$ 1682 cm.$^{-1}$ seems to suggest that sesquichamene may have a linkage of 1-methyl-cyclohexene-(1) if cedrene has a linkage of 1-methyl-cyclopentene-(1). AUTHORS.

5570. Raman Spectrum of Piperidine. S. M. Mitra. *Zeits. f. Physik*, 102. 9–10. *pp.* 697–699, 1936.—The investigation was carried out to find the positions of weak lines and to assign the frequencies. One new line is reported. Comparison is made with recorded data on piperidine and on cyclohexanes. W. R. A.

5571. Lines of the Second Order in Raman Spectra. G. S. Landsberg and V. J. Malyšev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 8. *pp.* 365–368, 1936. *In French.*—The second order Raman frequencies of carbon tetrachloride and stannic bromide have been measured. The orientation of the frequencies has been confirmed by calculation, and by consideration of the intensities of the scattered lines. The intensities are of the order predicted by theory and their variation with temperature is discussed. W. R. A.

5572. Relation between the Baeyer Tension T and the Characteristic Raman Frequency of the Cyclic Hydrocarbons. M. Aubert. *Comptes Rendus*, 203. *pp*. 661–663, *Oct*. 12, 1936.—The strain, T, produced by the deformation of the linkage angles in cyclic carbon compounds is expressed after Baeyer by $T = (10800–2116n)/n$. This shows a linear relationship $(\nu = 0{\cdot}2266\,T + 868)$ with the characteristic Raman frequencies for cyclic compounds without side chains. The experimental relationship $(n\nu^2 = 38{\cdot}5 \times 10^5)$ of Godchot, Canals and Cauquil for $n = 5$, 6, 7 and 8 is a particular case of this. H. G. C.

5573. Raman Effect and Molecular Structure of N_2O_5. J. Chedin and Jeanne C. Pradier. *Comptes Rendus*, 203. *pp*. 722–724, *Oct*. 19, 1936.—In solution in HNO_3 or H_2SO_4 nitric anhydride N_2O_5 is known to give Raman frequencies $\Delta\nu = 1050$ and 1400 cm^{-1}. It is now found that in solution in CCl_4 it gives $\Delta\nu = 860$, 1244 and 1355 cm^{-1}. Experiments with the crystalline substance, kept cool in a Dewar vessel, give $\Delta\nu = 1051$ and 1400 cm^{-1}., thus proving that N_2O_5 possesses the same structure in HNO_3 and H_2SO_4 as it does in the crystalline form, *i.e.*, strongly polymerised. In CCl_4, on the other hand, N_2O_5 must be monomolecular, since a solution in $POCl_3$ (in which cryoscopic evidence indicates single molecules) also gives $\Delta\nu = 1243$ and 1337 cm^{-1}. It is pointed out, moreover, that the infra-red spectra of N_2O_5 in the gaseous state and in CCl_4 solution are identical. L. A. W.

5574. Raman Effect and Molecular Structure of the Peroxide of Diphenylglyoxime. M. Milone. *Accad. Sci. Torino, Atti*. 71. *Disp*.3*a*. *pp*. 530–537, *May–Oct*., 1936.—The author concludes from measurements of the Raman effect that the molecule cannot have the same structure as that of dinitrosostilbene although that would be compatible with the X-ray data. R. P.

5575. Raman Spectra of Boron Halides. T. F. Anderson, E. N. Lassettre and D. M. Yost. *J. Chem. Phys*. 4. *pp*. 703–707, *Nov*., 1936. —The Raman frequencies $\nu_1\{1\}$, $2\nu_2\{2\}$, $\nu_3\{2\}$, and $\nu_4\{2\}$ for $BF_3(g)$, $BCl_3(l)$, and $BBr_3(l)$ were found to be 886 and 783, 1394, 1038 and 1105, 440; 471, 924, 958 and 996, 243; 279, 743, 806 and 846, and 151 cm^{-1}., respectively. The assignment of frequencies was determined by polarisation experiments on BCl_3 and is confirmed for the three compounds by the results of a normal coordinate treatment. The doubling of ν_1 in BF_3 is ascribed to vibrational resonance between ν_1 and $2\nu_4$. The doubling of ν_3 in all three compounds is shown to be due to the presence of the two isotopes of boron B^{10} and B^{11}. A satisfactory assignment of the infra-red frequencies of BCl_3 is made. AUTHORS.

***5576. Automatic Recording Spectrograph for the Near Infra-Red (6000–9500 Å). P. Barchewitz and A. Naherniac.** *Comptes Rendus*, 203. *pp*. 715–716, *Oct*. 19, 1936.—A plane grating is used with two lenses corrected for this region, and a photo-cell is used with a 3-valve amplifier as detector. The recording mechanism is similar to that used by Lecomte [see Abstract 3007 (1933)]. It is claimed that bands can be measured to ± 3 Å and the time of recording about 5 min. F. S.

See also Abstracts **5498, 5533, 5601, 5602, 5610, 5648, 5651.**

VELOCITY OF LIGHT.

See Abstract **5551.**

X-RAYS.

*5577. **Output of X-Rays from Al by Bombardment with Protons. O. Peter.** *Ann. d. Physik*, 27. 4. *pp.* 299–311, *Oct.*, 1936.—An investigation of the production of X-rays from light metals such as Al by bombardment with fast protons of uniform velocity, is carried out with the object of determining the absolute output of radiation, which, in the case of Al, is shown to be its K-radiation. The apparatus necessary for producing and counting the incident protons and also for determining the number of quanta produced by them, is fully described. The counting chamber was constructed on the guard ring principle. Protons of energy between 30 and 150 kV were used. An excitation function curve is obtained which is found to compare well with Henneberg's theoretical curve, which is proportional to the fourth power of the proton energy. A detailed discussion of the results for protons of 132 kV energy is given and it is shown that the ratio of radiated X-ray quanta to the number of incident protons is $(6 \cdot 22 \pm 0 \cdot 31) \times 10^{-6}$. G. O. B.

5578. **Atomic Dispersion and Absorption of X-Rays in Dirac's Relativistic Wave Mechanics. Part I. K. Seiler.** *Ann. d. Physik*, 27. 4. *pp.* 329–372, *Oct.*, 1936.—The dispersion and absorption of X-rays, as far as it is due to the K-electrons, is calculated with the aid of Dirac's equation. For this purpose the field is replaced by a Coulomb field and the errors due to this approximation are qualitatively discussed. In the calculation of the matrix elements approximations are made which amount to an expansion in powers of the atomic number. It is, however, shown that this produces, even for heavy elements, only errors of a few per cent of the relativity correction. The absorption coefficient is calculated and is compared with measurements, in particular of the absorption near the K-edge. The agreement is satisfactory, the largest part of the difference between the observed value and that calculated on the non-relativistic theory being removed. The wave-length dependence of the absorption coefficient is discussed, but here only an approximate comparison with the experiment is possible owing to the uncertainty in the values of the scattering coefficient. R. P.

5579. **Ionisation of Carbon Disulphide by X-Rays. L. S. Taylor.** *Bureau of Standards, J. of Research*, 17. *pp.* 557–576, *Oct.*, 1936.—The conductivity of CS_2 exposed to X-rays varies with time of application of voltage and time of exposure. It is shown that the phenomena observed can be explained by potential barriers due to space-charge. Effects with X-rays appear to differ only in degree with those observed without X-rays. Barrier potentials are measured and the current-decay curves studied. A method of deriving the saturation current is given and applied to the investigation of saturation conditions of several types of ionisation chamber with different X-ray intensities and qualities. The application of this work to the problem of radiation measurements is discussed. C. J. B. C.

5580. **Weak Emissions in the L-Spectrum of Radium (88). H. Hulubei.** *Comptes Rendus*, 203. *pp.* 665–667, *Oct.* 12, 1936.—The L-absorption spectrum, the stronger L-emission, and the energy levels of Ra have been given [see Abstract 4763 (1936)]. Feebler rays are listed and identified and some comparison made with the spectra of neighbouring elements. H. G. C.

5581. X-Ray Emission Spectrum and Chemical Combination. Part IV. K$\alpha_1\alpha_2$ Lines of Phosphorus Compounds. O. Lundquist. *Zeits. f. Physik*, 102. 11–12. *pp.* 768–771, 1936.—Results of the investigation of the K$\alpha_1\alpha_2$ doublet of P are given. The investigation concerns the hypophosphites, phosphites and phosphates of Na and Ca and also red phosphorus. The doublets of the compounds are, as is to be expected, shifted towards the shorter waves in relation to the doublet of red P. The shift amounts on the average to 1·58 X.U. for the hypophosphite, 2·19 X.U. for the phosphite, and 2·49 X.U. for the phosphate. [For Part III see Abstract 3327 (1934).] J. J. S.

5582. K X-Ray Absorption Spectra of Compounds of Bromine, Rubidium and Strontium. S. T. Stephenson. *Phys. Rev.* 50. *pp.* 790–792, *Nov.* 1, 1936.—The K X-ray absorption spectrum of Br in solid AgBr and in each of the vapours CH_3Br, C_2H_5Br and Br_2 is obtained with a double crystal ionisation spectrometer. Edge widths and the positions of secondary fine structure are given and discussed. The small widths given are checked by narrow K edges obtained for Rb in RbBr and Sr in $SrCl_2$ and are shown to be in agreement with data on emission line widths. The effect of chemical combination on the wave-length position of the main edge is discussed. AUTHOR.

5583. X-Ray Absorption Spectra of RbCl, RbI and Rb_2SO_4. A. E. Sandström. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 8. [3 *pp.*], 1936. *In English.*—The L_{II} and L_{III} edges of RbCl, RbI and Rb_2SO_4 are photographed with a concave crystal spectrograph; the measurements being carried out on photometrical curves of the spectrograms. The wave-lengths of the edges and of the accompanying " white lines " are given. There is no difference between the wave-lengths of the edges of the three compounds but the " white lines " show a systematic change indicating that the lattice constant and crystal structure influence the position of these minimum points. The widths of the edges and " lines " are also measured; the latter vary with the compound. C. J. B. C.

5584. Wave-Lengths in the K-Series of the Heavy Elements. E. Ingelstam. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 25*B*. *No.* 9. [2 *pp.*], 1936. *In English.*—Employing the method previously described [see Abstract 1200 (1934)], the wave-length of the head lines Kα_2, α_1, β_3 and β_1 of 14 elements between 51Sb and 79Au are determined. The measurements are carried out in the second or third order of reflection by means of a crystal grating with the small constant $d=1794$ X.U. The estimated accuracy is 0·015 X.U. for elements 51 to 60 and 0·010 X.U. for elements 73 to 79. A number of dipole and quadrupole lines are also recorded. C. J. B. C.

***5585. Measurement of X-Ray Intensity. V. Veksler and B. Isayev.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 8. *pp.* 369–370, 1936. *In English.*—A description of some preliminary attempts to measure the intensity of X-rays with a small cylindrical ionisation chamber filled with a mixture of Kr (85 %) and Xe (15 %) at a pressure of 660 mm. Hg, is given. The cylinder was kept at a high negative potential. A large amplifying factor is claimed for this type of chamber, which makes possible the use of a mirror galvanometer instead of an electrometer. G. O. B.

See also Abstracts 5384, 5643, 5704.

HEAT.

CALORIMETRY.

5586. Effect of Temperature on Specific Heat and Electrical Resistance of Cerium and Lanthanum. F. M. Jaeger, J. A. Bottema and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 39. 8. *pp.* 912–927, 1936.—Massive blocks about 20 gm. of Ce and La, both about 98 % purity with 1 % Fe, are turned to fit Pt crucibles, about 28 gm. in weight. Specific heats are determined from the quantities of heat evolved on cooling from various temperatures up to 550° C. and 750° C. respectively. Anomalous results are obtained for Ce in the intervals 320–380°, and 500–530°, and for La in the interval 420–665°. Differential heat capacity curves against Cu, obtained by the Saladin-le Chatelier method, show points at 362° and 502° for Ce, and at 548°, 665°, and 709° for La. The plot of electrical resistance against temperature shows points at 395° and 440° for Ce, and at 421°, 436°, 560° and about 675° for La. It is concluded that Ce is a mosaic of β (stable up to 393°), γ (stable 393°–440°), and δ (stable above 440°); and that a new modification (δ) of La appears above 709° C. Both elements show values of atomic heat exceeding 3R at moderate or low temperatures. For Ce, $C_p = 7\cdot3377 + 0\cdot43493 \times 10^{-2} (\theta - 380)$; for La, a number of equations are discussed.
D. R. H.

5587. Atomic Heats of Platinum and of Copper from 1·2 to 20° K. J. A. Kok and W. H. Keesom. *K. Onnes Lab. Leiden, Comm. No.* 245*a*. *Physica,* 3. *pp.* 1035–1045, *Nov.,* 1936. *In English.*—This paper deals with measurements concerning the atomic heats of Pt and Cu. It appears that the atomic heats can be represented by: $C_v = D(233/T) + 0\cdot001607\ T$ in the case of Pt, $C_v = D(335/T) + 0\cdot0001777\ T$ in the case of Cu. Discussion shows that the density of the energy levels in the energy band corresponding to the 5*d* electrons for Pt must be several times the density corresponding to perfectly free electrons. Comparison with susceptibility data suggests the existence of an appreciable interaction effect between neighbouring electron spins. For Cu the density of the energy levels (at the highest level) is only 1·5 times the density corresponding to perfectly free 4*s* electrons. AUTHORS.

5588. Determination of Specific Heat and Thermal Conductivity in a Single Experiment without Thermometry. W. M. Evans. *Phil. Mag.* 22. *pp.* 833–837, *Nov.,* 1936.—The experiment described is a modification of the determination of the specific heat by means of a Joly steam calorimeter. The apparatus is set up as for the usual method, but instead of waiting until equilibrium is reached the times are noted at which certain weights are reached, during the second half of the condensation. The usual corrections for radiation, buoyancy, etc., are made and values of m/m_0 are calculated for various times, m being the mass condensed, and m_0 its final value. This ratio is taken as the ratio of the amounts of heat concerned, and it is plotted against the time. The curve obtained is compared with a theoretical curve obtained from the consideration of the heat conductivity or diffusion function, and values for the specific heat and the thermal conductivity are calculated. If the material is in the form of a powder it is put into a metal sphere, otherwise it is obtained in the form of a sphere. The errors arising in the determination are discussed. E. H. D.

***5589. Gas Calorimetry. C. V. Boys.** *Phys. Soc., Proc.* 48. *pp.* 881–898, *Nov.* 1, 1936. *Guthrie Lecture.*—Some of the faults of the water-flow calorimeter now used for the examination of the calorific value of gas are discussed. A new gas calorimeter is designed for commercial use, and a modification suggested for work of the highest accuracy on the heats of combustion of the standard gases. A special feature of the calorimeter is the elimination of the destructive action of the gases and products of combustion which may be acid and highly corrosive. Temperatures are measured by means of a differential electrical thermometer with recording mechanism. Two other units are described for use in conjunction with this calorimeter: a water-supply unit and a gas-supply unit. The whole apparatus is robust, simple in operation, and should function for many years without any repairs or replacements being necessary. It has proved entirely satisfactory during tests. C. J. B. C.

See also Abstracts 5592, 5599, 5613, 5616.

CONDUCTION.

See Abstract 5588.

CONVECTION.

See Abstract 5409.

DILATATION.

***5590. Dilatograph with Photographic Registration. P. I. Andrianow.** *Kolloid Zeits.* 77. *pp.* 38–44, *Oct.*, 1936.—A detailed description is given of a dilatograph in which the volume alterations of the specimen under investigation cause alterations in the level of a quantity of mercury in which the specimen is submerged. This is turn causes alterations in the effective length and electrical resistance of a wire dipping into the mercury. Consequent variations of electric current are registered photographically by the agency of a mirror galvanometer. Examples of records for the freezing of soil specimens are reproduced. L. A. W.

MELTING AND BOILING POINTS.

5591. Freezing-Point Curves of Dicetyl in Propane and Butane. W. F. Seyer and R. Fordyce. *Am. Chem. Soc., J.* 58. *pp.* 2029–2031, *Oct.*, 1936.—The freezing points of solutions of dotriacontane (dicetyl) in propane and in butane are found. The curves constructed from the freezing point data indicate the occurrence of two forms of the high molecular weight hydrocarbon. Change of refractive index with temperature shows this to be the case and that the transition temperature is about 55°. AUTHORS.

5592. Heat of Fusion and Vapour Pressure of Stannic Iodide. G. R. Negishi. *Am. Chem. Soc., J.* 58. *pp.* 2293–2296, *Nov.*, 1936.—The melting point of stannic iodide is determined by the cooling method, and the value obtained was $144\cdot5 \pm 0\cdot1°$. The vapour pressure of stannic iodide from its melting point to 250° is determined by means of a glass click gauge. The molal heat of vaporisation calculated from the vapour pressure is 13,750 ± 50 cal./mol. at 25° and varies but little with temperature. The heat of fusion of stannic iodide is found to be 4600 ± 20 cal./mol. at the melting point. The molal heat capacity of the solid can be expressed within 0·8 % of the measured values in the temperature range 25° to the melting point by C_p 19·4 + 0·036T, while that of the liquid, from the melting point to 170° is 40·1 ± 0·5 cal./mol. AUTHOR.

5593. Ebulliometric Study of Alcohols. M. Wojciechowski. *Bureau of Standards, J. of Research*, 17. *pp.* 721–726, *Nov.*, 1936.—The following normal aliphatic alcohols: methanol, ethanol, *n*-propanol, *n*-butanol, and *n*-amyl alcohol, were prepared in a state of high purity. By the use of Swietoslawski's ebulliometric technique, and the comparative method of measurements using water as a reference liquid, the following numerical data were obtained:

	Methanol	Ethanol	*n*-Propanol	*n*-Butanol	*n*-Amyl Alcohol
Boiling Point (°C.)	64·509	78·325	97·209	117·726	138·06
dt/dp (°C./mm. Hg)	0·0331	0·0334	0·0344	0·0372	0·0402

Beginning with *n*-propanol, the introduction of a CH_2 group into the chain of a normal aliphatic alcohol molecule has a specific effect, increasing *dt/dp* by a constant value of 0·0029—the same amount as in the case of aliphatic hydrocarbons. The ebulliometric control of purity of the preparations, the use of substances of extreme purity, and the application of the method of comparative measurements ensure the accuracy of the results reported. [See Abstract 4777 (1936).] AUTHOR.

5594. Evaporation of Water from Plane and Cylindrical Surfaces. R. W. Powell and E. Griffiths. *Inst. Chem. Eng., Trans.* 13. *pp.* 175–198, 1935.—Experiments are described to determine the laws governing the rate of evaporation of water from saturated plane and cylindrical surfaces maintained at uniform temperatures ranging up to 20° C. above that of the air, and subjected to steady wind streams having velocities of 60 to 260 cm./sec. Each surface was built up of a number of independently controlled strip heaters, over which a sheet of linen was stretched and maintained saturated. In this way it was possible to study the variation in the rate of evaporation over the area of the surface. For the cylinder with its axis perpendicular to the wind direction the rate of evaporation assumes maximum values at the front and rear surfaces and minimum values at the sides. For the plane surface subjected to a tangential wind, the rate of evaporation decreases as the distance from the leading edge increases. Provided the plane surface exceeds 20 cm. in width and the wind speed exceeds 100 cm./sec. the rate of total evaporation in gm./sec. from an area of length l and width b cm. is given by $E_w = 2{\cdot}12 \times 10^{-7} l^{0.77} b(p_w - p_a)(1 + 0{\cdot}121u^{0.85})$, where u is the air velocity in cm./sec. and $(p_w - p_a)$ is the vapour-pressure difference in mm. of Hg between the saturated surface and the air at a distance. The influence of a ridge running parallel to the leading edge and projecting slightly above the plane surface is also studied. The present results are compared with the somewhat diverse theoretical predictions and experimental values given by other workers. R. W. P.

5595. Evaporation of Nickel in a Vacuum. G. Bryce. *Chem. Soc., J. pp.* 1517–1518, *Oct.*, 1936.—The rate of evaporation of Ni in a vacuum has been measured [see Abstract 139 (1928)] by determining the loss in weight undergone by filaments heated to temperatures in the range 1318–1602° K. It has now been found more accurate to analyse the metal evaporated, and, on account of its great sensitivity, this method has the advantages of avoiding the difficulty of keeping the temperature constant whilst the filament becomes much thinner, and also of being useful for determining the quantities of metal evaporated during short experiments in the presence of gases. H. H. Ho.

See also Abstracts **5343, 5598, 5612.**

TEMPERATURE, MEASUREMENT OF.

5596. Gas Thermometer Temperature Scale. W. H. Keesom and W. Tuyn. *Bureau Internat. des Poids et Mesures, Travaux et Mem.* 20. 1936. *K. Onnes Lab. Leiden, Comm. Nos.* 229–240. *Suppt. No.* 78. *pp.* 1–85, 1936.—The gas thermometer scale of temperature is considered in relation to the Kelvin scale and practical thermometric scales. It is suggested that a new scale based on the fundamental temperature coefficient should be adopted for low-temperature work, and the researches of Berthelot and Kamerlingh Onnes in this direction are considered at some length. The new scale is called the Centigrade-Avogadro scale, and a large amount of literature on the subject of the determination of this constant is discussed at length. The temperature scales and the scales of the normal (constant volume, with a stated initial pressure) gas thermometer at Leiden, the Reichsanstalt and the Massachusetts Institute of Technology are examined. The reduction of the normal gas thermometer temperatures to the Centigrade-Avogadro scale is propounded and tables are given showing the corrections which have to be applied. A very large amount of data is examined, and the values for the constants used at Leiden are He 0·0036607, H_2 0·0036622, N_2 0·0036742. Finally, there are two Appendices; one giving the definitions of various terms used in the text, the other dealing with the reduction of the Centigrade scale to the H_2 gas thermometer scale. E. H. D.

***5597. Gas-Tight Furnace for Thermocouple Standardisation. C. D. Niven.** *Canad. J. of Research,* 14. *Sect. A. pp.* 177–180, *Sept.,* 1936.—Difficulties encountered in making a furnace, for the standardisation of a primary standard thermocouple, according to the specification of Foote, Fairchild, and Harrison led to the design of a more suitable furnace. The furnace here described has a lid which is sealed on with wax, but this is prevented from melting by arranging a water cooling system in the lid. A device for removing crucibles from the furnace is illustrated and briefly described. E. H. D.

5598. Cooling by Simon Desorption Method between Temperatures of 90° and 40° K. A. van Itterbeek and W. Vereycken. *Physica,* 3. *pp.* 954–958, *Nov.,* 1936. *In English.*—Further experiments on the Simon desorption method [see Abstract 3744 (1936)] are carried out; a systematic investigation concerning the influence of the equilibrium pressure on the temperature decrease is made; this influence is found to be considerable. Measurements are made at 90° K. and 70° K. at pressures lower than one atmosphere, and also at 90. K. at pressures up to 5 atm. At 90° and 70° K. a temperature decrease is found respectively of 28·8° and 24·6° K. for an equilibium pressure of about 1 atm. At 90° K. a temperature decrease is found of 38·3° K. for an equilibrium pressure of 5 atm. AUTHORS.

THERMOCHEMISTRY.

5599. Heat Content and Heat Capacity of Aqueous Sodium Chloride Solutions. T. F. Young and J. S. Machin. *Am. Chem. Soc., J.* 58. *pp.* 2254–2260, *Nov.,* 1936.—Differential heats of dilution to be used with cryoscopic data for the evaluation of activity coeficients of NaCl in aqueous solution are obtained (by the chord-area method) from appropriate calorimetric measurements at 0, 12·5 and 25°. These dilution data are combined with those of Gulbransen and Robinson (extrapolated to infinite dilution by the method of Young and Groenier) to demonstrate that the apparent molal heat capacity of NaCl in aqueous solution is not a linear function of the square root of molality. Many of the discrepancies between various precise measurements of the heat capacities of electrolytes, and the limiting law derived from the Debye-Hückel theory arose from linear extrapolations. Others are probably due to extrapolations which are too nearly linear. The theory is in agreement with measurements of the heats of dilution of aqueous NaCl solutions. AUTHORS.

5600. Single Bond Energies. Part IV. Vapour Pressure of Hexaphenylethane. G. R. Cuthbertson and H. E. Bent. *Am. Chem. Soc., J.* 58. *pp.* 2000–2003, *Oct.,* 1936.—The vapour pressures of triphenylmethane, hexaphenylethane and triphenylmethyl peroxide are measured by means of a quartz fibre gauge. The values calculated for the heat of vaporisation of these compounds indicate that the C–C bond in hexaphenylethane in the vapour state is weaker than a normal C–C bond. The heat of dissociation, however, is probably greater than that found for hexaphenylethane in solution. [For Part III see Abstract 5203 (1936).] AUTHORS.

5601. Spectroscopic Study of the Detonation of Prime Explosives. H. Muraour. *J. de Physique et le Radium,* 7. *pp.* 411–416, *Oct.,* 1936.—A study is made of the detonation of explosives *in vacuo* particularly the nitrides and fulminates of the heavy metals, by means of their spectra. Details of apparatus together with relevant data are included. The spectra obtained are not those of flame, and may be useful for ascertaining the degree of excitation of the metallic atom liberated at the moment of explosion and on the mechanism of detonation. H. H. Ho.

5602. Luminous Phenomena in the Detonation of Prime Explosives. H. Muraour and A. Langevin. *J. de Physique et le Radium,* 7. *pp.* 417–419, *Oct.,* 1936.—By means of a photographic device, which is explained in detail, it is shown that the luminous phenomena which accompany the detonation of an explosive are very different according as the detonation is produced in air or *in vacuo.* In air, the luminosity is very short and depends on the ignition or not of the gases liberated by the combustion. In an enclosed cylinder or *in vacuo* the detonation gives rise to a luminous condensation which is reflected at the extremities of the cylinder and is propagated at a velocity of 740 m. per sec., if the explosive is lead nitride, at 745 m. with silver nitride, at 630 m. with mercury nitride and at 1000 m. with m-nitrobenzenediazonium perchlorate. These velocities are of the same order of magnitude as those determined for the velocity of sound in the detonation products at high temperatures. H. H. Ho.

5603. Colloid Chemical Reactions at High Temperature. S. I. Djatschkowsky. *Kolloid Zeits.* 77. *pp.* 74–78, *Oct.*, 1936.—The present paper is concerned with the reduction of the disperse phase of colloidal systems by hydrogen at high temperatures (200°) and pressures (200 atm.). For colloidal iron hydroxide all the stages of the reaction process have been determined, from dehydration to the reduction to metallic iron : $Fe_2O_3\, nH_2O \rightleftharpoons Fe_2O_3 \cdot 5H_2O \rightleftharpoons Fe_2O_3 \cdot 2H_2O \rightleftharpoons Fe_2O_3 \cdot H_2O \rightleftharpoons HFeO_2 \rightleftharpoons Fe_2O_3 \rightleftharpoons Fe$. Colloidal chromium hydroxide is very stable and does not undergo reduction. [See also Abstract 1265 (1936).] J. K.

See also Abstracts **5388, 5522, 5589, 5613, 5616, 5673.**

THERMODYNAMICS.

5604. Absolute Temperature and the Principal Thermodynamic Relations. F. Odone. *Accad. Lincei, Atti,* 23. *pp.* 865–870, *June* 5, 1936. *N. Cimento,* 13, *pp.* 310-325, *July,* 1936.—If θ is the temperature as read on any thermometer and the absolute temperature, T is a function of θ only, the condition that $1/T$ should be an integrating factor of dQ, the infinitesimal change in heat, is that $dQ = dW + H d\theta$, where dW is an exact differential and $H + WT'/T$ is a function of θ only. If in addition T is always the same whatever may be the values of W and H, then T is defined to be the absolute temperature. The author then proceeds to deduce from this definition of the absolute temperature the principal thermodynamic relations. A. J. McC.

5605. Compensation States (Basis Line) of Helium and Carbonic Acid. Part I. W. Jacyna. *Zeits. f. Physik,* 103. 1–2. *pp.* 61–66, 1936.—The aperiodic form of the line of the compensation states (basis line) has been calculated for CO_2, and a comparison made with the van der Waals-Berthelot parabolic form in the light of the experimental data recorded by Kamerlingh Onnes, Keesom, etc., for He and by Amagat for CO_2. The fundamental significance of the basis line for the derivation of the basis function of the equation of state is discussed. H. H. Ho.

5606. U-Effect of H. Amagat and P. Weiss. W. Jacyna. *Zeits. f. Physik,* 103. 1–2. *pp.* 67–75, 1936.—This paper is Part II of a study of the equation of state based on the selection theorem and on the Joule-Thomson effect [see Abstract 1765 (1936)], and in it the volume deviation $\Delta v = v - R\psi/p$ is calculated with the limiting conditions $(\mu_J)_{p=0} = 0$ and $(\mu_U)_{p=0} = 0$. The Δv-expression so obtained is applied to the derivation of the equation of state, and following it is given the general and unique conception of the *U*-effect which was first experimentally discovered in the region of high pressure by Amagat in 1894, and more recently has been computed at high temperatures by Weiss, Roebuck, Osterberg and others. H. H. Ho.

5607. Specific Heats of Liquids and Gases. R. Lucas. *Comptes Rendus,* 203. *pp.* 773–774, *Oct.* 26, 1936.—L. Brillouin [see Abstract 2797 (1936)] has proposed developing a quantum theory of specific heat of monatomic liquids following an extension of the method successfully employed in the case of solids. With liquids the transverse waves of thermal agitation would be replaced by liquid turbulences carrying a purely kinetic contribution to the energy of the longitudinal waves, which have only been taken into consideration by Debye. It is shown that classical ideas justify completely the existence of transverse waves, and that it is possible, by taking account of them, to develop a quantum theory of specific heat of fluids analogous to that of solids. The calculations lead to a value 2R for the specific heat at constant volume of a perfect liquid, or 4 cal./gm.-atom at high temperatures. The corresponding calculation for a perfect gas gives 3/2 R, or 3 cal./gm.-atom at a sufficiently high temperature, which is in accord with the kinetic theory of gases. C. J. B. C.

5608. Phase Equilibria and Optical Properties of Na_2O-B_2O_3 Glasses. G. W. Morey and H. E. Merwin. *Am. Chem. Soc., J.* 58. *pp.* 2248–2254, *Nov.*, 1936.—A study of the phase equilibrium relationships in the system Na_2O–B_2O_3 has shown the existence of the compounds: $2Na_2O \cdot B_2O_3$, $Na_2O \cdot B_2O_3$, $Na_2O \cdot 2B_2O_3$, with congruent melting points at 625°, 966° and 742° respectively; $Na_2O \cdot 3B_2O_3$, with an incongruent melting point at 766°, 76 weight % B_2O_3; and $Na_2O \cdot 4B_2O_3$, with a congruent melting point at 816°. The orthoborate, which is a newly discovered compound, can be cooled to a glass, as can mixtures containing more boric oxide than the diborate. The metaborate and compositions near it crystallise too readily to be quenched to a glass. In addition to the forms stable at the liquidus, sodium diborate may occur in two, and the tetraborate in one, additional form which are probably monotropic. Attempts to prepare crystalline boric oxide were not successful, and doubt is expressed as to previous claims to its crystallisation. Refractive dispersions were measured for boric oxide, sodium tetraborate and sodium diborate glasses. AUTHORS.

5609. Entropy of Deuterium Oxide and the Third Law of Thermodynamics. E. A. Long and J. D. Kemp. *Am. Chem. Soc., J.* 58. *pp.* 1829–1834, *Oct.*, 1936.—The heat capacity of solid and liquid D_2O is determined over their respective ranges from 15° to 298° K. The melting point is found to be 276·92° K. The heat of fusion of D_2O is 1501 cal./mol. The calorimetric entropy of liquid D_2O at 298·1° K. is 17·27 e.u. The value which should be used in thermodynamic calculations is 0·806 e.u. higher, or 1808 e.u., on the basis of Pauling's theory. Using the measured heat capacities and the heat of sublimation of D_2O given by Bartholomé and Clusius (639·0 cal./gm.), the calorimetric entropy for D_2O(g,) is found to be 45·89 e.u. at 273·10° K. and 1 atm. pressure. The entropy from spectroscopic data is 46·66 e.u., giving a discrepancy of 0·77 e.u. between the calorimetric and spectroscopic values. This is in good agreement with the theoretical discrepancy 0·806 calculated by Pauling from the assumption of random orientation of the H bonds in the crystal. This agreement, along with the similar one for H_2O found by Giauque and Stout [see Abstract 4284 (1936)] is evidence for the correctness of Pauling's theory. H. H. Ho.

5610. Entropy of Carbon Tetrachloride. R. C. Lord, Jr., and E. R. Blanchard. *J. Chem. Phys.* 4. *pp.* 707–710, *Nov.*, 1936.—A new calculation of the entropy of CCl_4 has been made from Raman spectra and electron diffraction data. The effect of the isotopes of Cl has been investigated. A new value of the calorimetric entropy has been computed from recent (and in part unpublished) thermal data. The agreement of the entropies leaves little reason to doubt the validity of the spectroscopic calculations. AUTHORS.

5611. Thermodynamic Properties of the Tellurides of Zinc, Cadmium, Tin and Lead. J. H. McAteer and H. Seltz. *Am. Chem. Soc., J.* 58. *pp.* 2081–2084, *Nov.*, 1936.—A potentiometric study of the tellurides of Zn, Cd, Sn and Pb is made at higher temperatures using fused salt electrolytes. The method is shown to give results which are reliable and accurate when applied to the proper substances. The data thus obtained are employed in calculating the free energies of formation, heats of formation and entropies of formation at 25°. AUTHORS.

5612. Thermodynamics of Aqueous Indium Sulphate Solutions. E. M. Hattox and T. de Vries. *Am. Chem. Soc., J.* 58. *pp.* 2126–2129, *Nov.*, 1936.—Using cells of the type In(s), $In_2(SO_4)_3$–(m), Hg_2SO_4–Hg e.m.f. measurements are made at 0, 15, 25 and 35°. The freezing points of dilute solutions of $In_2(SO_4)_3$ are investigated. Calculations are made of the activity coefficients and of the partial molal heat contents relative to the 0·01 *M* solution. pH values of solutions of $In_2(SO_4)_3$ are determined at room-temperature, using the quinhydrone electrode. The constant for the hydrolysis of $In_2(SO_4)_3$ is calculated assuming the reaction to be $In^{+++} + H_2O = In(OH)^{++} + H^+$. AUTHORS.

5613. Heat Capacity and Entropy of Potassium Permanganate. O. L. I. Brown, W. V. Smith and W. M. Latimer. *Am. Chem. Soc., J.* 58. *pp.* 2144–2146, *Nov.*, 1936.—The heat capacity of $KMnO_4$ is measured from 15 to 300° K., and the entropy of the salt determined by graphical integration to be 41·04 e.u. Coupling this value with the entropy of solution, and the entropy of K-ion herein adopted, the entropy of permanganate ion is determined to be 46·7 e.u. The free energy of formation of $KMnO_4$ and of permanganate ion are computed from the known entropies and heat of formation. AUTHORS.

5614. Activity of Sodium and Mercury in Solid Sodium Amalgams. H. E. Bent and A. F. Forziati. *Am. Chem. Soc., J.* 58. *pp.* 2220–2223, *Nov.*, 1936.—A potentiometric method is described for studying intermetallic compounds at room-temperature. Values are given for the free energy of formation of $NaHg_4$, $NaHg_2$, NaHg, Na_2Hg_2 and Na_3Hg. The value for Na_2Hg_2 is not so reliable. The activity of Hg and Na in solid amalgams of all concentrations is computed. AUTHORS.

5615. Activity of Sodium in Dilute Sodium Amalgams. H. E. Bent and E. Swift, Jr. *Am. Chem. Soc., J.* 58. *pp.* 2216–2220, *Nov.*, 1936.—The thermodynamic properties of dilute sodium amalgams are determined by means of concentration cells containing NaI in dimethylamine as the electrolyte. The solubility of Na in Hg is determined at 5, 15 and 25°. The experimental results are compared with those of Richards and Conant on concentration cells and Lewis and Kraus on the Na electrode. The data on very dilute amalgams indicate that deviations from Raoult's law, which can be largely attributed to the existence of compounds, cannot be quantitatively explained by the assumption that compounds exist which dissolve in Hg to give ideal solutions. AUTHORS.

5616. Entropy and Heat of Solution of Lithium Carbonate. O. L. I. Brown and W. M. Latimer. *Am. Chem. Soc., J.* 58. *pp.* 2228–2229, *Nov.*, 1936.—The heat capacity of Li_2CO_3 is measured from 16 to 300° K. The entropy at 298·1° K. obtained from these data is 21·60 e.u. The heat of solution in water at 298·1° K is determined. The entropy of Li ion calculated from these and other data is found to be 4·6 e.u. AUTHORS.

5617. Absolute Rate of a Chemical Reaction: Formal Thermodynamic Treatment. W. H. Rodebush. *J. Chem. Phys.* 4. *pp.* 744–746, *Nov.*, 1936.—In order to assign a definite value to the entropy of activation, it is necessary to make definite assumptions as to the topography of the energy surface traversed by the reacting system. When this is done, the entropy of activation becomes the difference between the entropy of the average molecule and the entropy of the activated complex at the steady state concentration required for unit rate of reaction. The racemisation of diphenyl derivatives is considered as a special case of unimolecular reaction where $h\nu \ll kT$. AUTHOR.

See also Abstract 5675.

VAPOUR PRESSURE.

5618. Normal Vapour Pressure of Crystalline Iodine. L. J. Gillespie and L. H. D. Fraser. *Am. Chem. Soc., J.* 58. *pp.* 2260–2263, *Nov.*, 1936.—The normal vapour pressure of solid iodine is measured directly by means of a flexible metallic diaphragm at 30, 40 and 60° with a precision of better than 0·004 mm. of Hg, or better than 0·22 %. The results agree with the equation deduced by Gerry and Gillespie from the data of Baxter and collaborators, as corrected for failure of the ideal gas laws, within the magnitude of these corrections. A table is given of vapour pressures derived from a combination of the new data with the corrected older data, as embodied in the modified equation of Giauque $\log_{10} p_{\text{atm}} = -3512{\cdot}830/T - 2{\cdot}013 \log T + 13{\cdot}37400$. The corresponding value of $\triangle H$ for the sublimation of iodine at 25° is 14880·7 cal_{15}/mol. AUTHORS.

5619. Vapour Pressure of Tetraethyl-Lead from 0° to 70° C. E. J. Buckler and R. G. W. Norrish. *Chem. Soc., J. pp.* 1567–1569, *Oct.*, 1936.—A static method is described for the determination of the vapour pressure of pure tetraethyl-lead at temperatures of from 0° to 70° C. The pressures were measured by a sensitive Bourdon gauge which was calibrated against a Hg manometer and found to give pointer deflections directly proportional to the pressure for pressure differences up to 20 mm. Hg. By observing the pointer with a travelling miscroscope the vapour pressures could be observed to 0·005 mm. Hg. The results over the above range of temperature can be presented by the formula, $\log_{10} p = 9{\cdot}428 - 2938/T$, p being the pressure in mm. Hg, and T the absolute temperature. They are 10 to 15 % higher than those extrapolated from a formula published for temperatures between 78° and 150° C. by Jones, Evans, Gulwell and Griffiths. [See Abstract 1129 (1935).] R. W. P.

5620. Distribution of Temperature and Vapour Pressure near a Water-Surface. R. D. Gupte. *Indian Acad. Sci., Proc.* 4*A. pp.* 275–282, *Sept.*, 1936.—The present paper describes the results of experiments made in the laboratory to determine the distribution of temperature and vapour pressure near an evaporating water-surface with wind speeds varying from 0 to 2½ m. per sec. Fine dry and wet thermocouples were used to determine the temperatures. It was noticed that when the water-surface was warmer than air, there were conspicuous fluctuations of temperature above the water-surface, the maximum fluctuations being at a height of about 1 cm. above the surface. A table is given showing the heights above the surface at which the temperature and vapour pressure changes amounted to one-half the total changes. AUTHOR.

See also Abstracts 5592, 5600.

ACOUSTICS.

5621. Vibration of a Liquid Membrane Exposed to H.F. Sound Waves. J. Hartmann and P. v. Mathes. *Phil. Mag.* 22. *pp.* 883–891, *Nov.*, 1936. *Supplement,*—A soap film is exposed to sound waves from a Hartmann air-jet generator of frequency 12400 and light passed through it to cast its image on a screen. Below a critical thickness the film responds to the sound and a diffraction pattern is shown in the image. For a circular film a granular appearance is produced, and for a rectangular film striations first appear at the top, spread over the film, and, just before the film breaks, become granulations. Theory is given to explain the phenomenon, and it is concluded that the natural state of vibration of a liquid film is that to which three sets of transverse stationary waves under 120° with each other would give rise. This is borne out by the photographs reproduced. H. M. B.

5622. Propagation of Sound in Partly Dissociated Gases. H. O. Kneser and O. Gauler. *Phys. Zeits.* 37. *pp.* 677–684, *Oct.* 1, 1936.—The velocity of sound in a partly dissociated gas is calculated and the influence of pressure, temperature and frequency examined. The results are compared with measurements made upon N_2O_4. It is found that the behaviour of this gas depends markedly upon its temperature. Good agreement is found between the measured and calculated variation of velocity with pressure. J. E. R. C.

***5623. Constancy of Velocity of Sound at Sonic Frequencies. F. A. Walch.** *Phys. Soc., Proc.* 48. *pp.* 899–913, *Disc.*, 913, *Nov.* 1, 1936.—A method of investigating whether there is any dispersion of sound waves in air at sonic frequency is described. It consists in comparing the wave-form of a complex sound at different distances from the source. A technique for making the necessary collodion diaphragms has been worked out, and a simple but effective drum camera constructed. A controllable wave-form is provided by two oscillators, one tuned to a fundamental and the other to a harmonic, locked into synchronism by close coupling. Frequencies from 250 to 1000 c./sec. have been investigated. Velocities have been proved constant for the lower frequencies to within 1 in 500 and for the higher frequencies to within 1 in 1000. AUTHOR.

5624. Interference between Waves Having a Modulated Frequency. J. Brillouin. *R.G.E.* 40. *pp.* 434–441, *Oct.* 3, 1936.—The beats which are formed when two frequency-modulated waves interfere are explained and the use of " warble " tones for acoustical measurements is examined. The production of a frequency-modulated tone by motion of the source or by rotating reflectors is described. The possibility of using the interference system to locate sound sources is also mentioned. J. E. R. C.

5625. Visibility of Ultrasonic Waves and its Periodic Variations. N. S. N. Nath. *Indian Acad. Sci., Proc.* 4*A*. *pp.* 262–274, *Sept.*, 1936.—The general theory of the visibility of ultrasonic waves is developed. The theory shows that the intensity grating on a general periodic corrugated (both amplitude and phase) wave-front of light will repeat itself on all those at distances from the original one by integral multiples

$2\lambda^{*2}/\lambda$, where λ^* is the wave-length of the corrugation and λ is the wave-length of light. Special cases are worked out to illustrate the theoretical results. These theoretical results await experimental confirmation. AUTHOR.

5626. Scattering of Elastic Waves in Fluids. R. Lucas. *Comptes Rendus*, 203. *pp.* 611–613, *Oct.* 5, 1936.—The abnormal scattering of ultrasonic waves in liquids has been described by several authors. To explain the phenomenon it is assumed that a liquid contains a number of small volumes having a compressibility different from that of the remainder of the liquid. The scattering is calculated and the possiblity of variations in the properties of the liquid arising from thermal agitation being sufficient to explain the observations is examined. It is concluded that larger differences are necessary and it is suggested that there must be volume elements (possibly crystalline aggregates) distributed through the liquids examined and having a compressibility very different from that of the liquid as a whole. J. E. R. C.

5627. Ultrasonic Diffraction of Light. Part I. R. Extermann and G. Wannier. *Helv. Phys. Acta*, 9. 7. *pp.* 520–532, 1936.—*In French.*—A theoretical treatment of the diffraction of light by a medium through which ultrasonic waves are passing. Numerical solutions in the form of graphs showing the intensity fluctuations are given for certain special cases in which the incident ray is perpendicular to the direction of propagation of the ultrasonic wave. A more general solution is promised in Part II. W. H. Ge.

5628. Demonstration of the Chladni Figures of Vibrating Quartz. R. Bär. *Helv. Phys. Acta*, 9. 7. *pp.* 617–625, 1936. *In German.*—The fact that the surface of a vibrating quartz crystal is not all in one phase leads to interference effects in the sound emitted from it. The interference effects are demonstrated optically by three methods. J. E. R. C.

5629. Photometric Investigations of Diffraction of Light by Ultrasonic Waves in Liquids and Gases. W. Korff. *Phys. Zeits.* 37. *pp.* 708–720, *Oct.* 15, 1936.—Light from a Hg arc was passed through a monochromator and the trough containing a vibrating quartz to a camera. The intensity ratio of the first and second order spectra was found by comparison with known intensities, using a photographic-photometric method. The results obtained by diffraction in air were compared with those expected from a modified Brillouin theory. The intensity ratio of the first to the zero order depends on the angle between the incident rays and the sound wave-front. This ratio has a maximum when the light rays strike the wave-front at the Bragg angle. The dependence of the distribution of intensity in the first order spectra on the length of the path of the light in the sound field and on the wave-length of the incident light was also investigated. The substances tested were water, xylol and air. G. E. A.

5630. Debye-Sears Effect. J. Hrdlička, M. A. Valouch and L. Zachoval. *Comptes Rendus*, 203. *pp.* 786–787, *Oct.* 26, 1936.—A method of measuring with monochromatic light the luminous intensity of the successive diffraction spectra of the Debye-Sears effect [see Abstract 4457 (1932)] is described and results are given for orders 0 (the central fringe), 1, and 2, for varying voltages (the frequency of the supersonic vibrations being constant and $= 2\times 10^6$). The results resemble those of Becker [see Abstract 1780 (1936)], but preliminary measurements for higher orders seem to imply that in these some other law is followed. C. A. S.

5631. Theory of Acoustic Coagulation. O. Brandt, H. Freund and E. Hiedemann. *Kolloid Zeits.* 77. *pp.* 103–115, *Oct.*, 1936.—In this paper, which continues previous work [see Abstract 3281 (1936)], a particularly simple and easily evaluated formula is derived, which enables the degree of the participation of a suspended particle in the acoustic oscillation in a stationary sound wave to be calculated with respect to dependence on particle size, frequency, etc. From this formula it follows that there is a definite frequency for each particle size in which it participates completely in the oscillation of the medium. On the other hand for a definite frequency, particles up to a critical radius participate in the oscillation. By this means the different behaviour of the particles of an aerosol with respect to the acoustic field are classified. In an anisodisperse system such as occurs during acoustic coagulation, it is shown how the course of the kinetic coagulation may be derived after various simplifying assumptions; numerical examples are given. The hydrodynamic forces between the particles which are a further cause of aggregation are also investigated and their influence is found to be appreciable at high ultrasonic frequencies, while at lower frequencies they recede. In actual cases both causes of aggregation operate together with other factors. Full experimental details with data, diagrams and photographs are included.

H. H. Ho.

5632. Formation of Fogs by Ultrasonic Waves. K. Söllner. *Faraday Soc., Trans.* 32. *pp.* 1532–1536, *Nov.*, 1936.—The formation of fogs of non-metallic liquids by ultrasonic waves is due to the same mechanism as all the other disruptive and destructive effects of ultrasonics, namely, to cavitation, or more correctly, to the vehement collapse of cavities. This collapse may be brought about by an external gas pressure or in the absence of a foreign gas by the vapour pressure of the irradiated liquid itself, provided that this vapour pressure is not too small; for this reason fog formation stops at low temperatures in absence of a foreign gas. The fact that the vapour pressure of irradiated liquids—in absence of a foreign gas—can effect the collapse of cavities explains also the fact that at higher temperatures the process of emulsification proceeds also *in vacuo, i.e.*, in absence of a foreign gas. The importance of fog formation in the oil bath for the technique of ultrasonics and for its further development is shortly discussed.

AUTHOR.

5633. Visible Cavitation Caused by Ultrasonic Waves. K. Söllner. *Faraday Soc., Trans.* 32. *pp.* 1537–1539, *Nov.*, 1936.—Cavitation by ultrasonic waves may be made directly visible, if long columns of degassed liquids are irradiated with high energy. Slightly glittering zones of slight opacity, which disappear without producing gas bubbles, are formed in the liquid when it disrupts, due to the stretching by the ultrasonic waves.

AUTHORS.

5634. Action of Ultrasonic Waves in Suspensions. F. J. Burger and K. Söllner. *Faraday Soc., Trans.* 32. *pp.* 1598–1603, *Nov.*, 1936.—With ultrasonics rod- or plate-like particles (mica, mosaic gold, gypsum, selenite, steatite, quartz, kaolin, etc.) can be orientated with their longest axis normal to the flux of energy. To produce this effect the energy may be below the limit necessary for accumulation. These results are obtained as a rule with particles of microscopic size, but orientation was also found in truly colloidal solutions of V_2O_5 and Fe_2O_3. Concentrated rheopectic suspensions of gypsum, kaolin and Solnhofen slate are solidified by ultrasonics of low and medium energy. The solidification is correlated to the accumulation of the particles by ultrasonics. If the energy applied is sufficiently high, these concentrated pastes also can be liquefied, as a consequence of cavitation. Mixtures of a sea-sand or quartz-powder with water which are normally dilatant lose this property, when exposed to ultrasonic waves. AUTHORS.

***5635. Vibration of a Building Partition at Audio Frequencies. J. E. R. Constable.** *Phys. Soc., Proc.* 48. *pp.* 914–918; *Disc.*, 922–923, *Nov.*, 1936.—A simple device for observing the vibration of a partition has been used for determining the resonance frequencies and associated resistance coefficients of a sheet of window glass. AUTHOR.

5636. Vibration Pattern of a Wall Transmitting Sound. J. E. R. Constable and G. H. Aston. *Phys. Soc., Proc.* 48. *pp.* 919–922; *Disc.*, 922–923, *Nov.* 1, 1936.—The vibration pattern of a 9-in. brick wall transmitting pure and warble notes of various frequencies has been determined by exploring the surface of the wall with an electromagnetic device. The pattern increases in complexity with increase of frequency. The effect of a warble tone is to decrease the difference between the greatest and least vibration energies. AUTHORS.

5637. Deviations in Loudness Judgments of 100 People. J. C. Steinberg and W. A. Munson. *Acoustical Soc. of America, J.* 8. *pp.* 71–80, *Oct.*, 1936.—Distributions of loudness judgments are shown for a large group of observers comparing 100- and 5000-cycle tones with a 1000-cycle reference tone. The tests were made with automatic equipment for conducting the constant stimuli type of test. Additional tests show how experience, hearing acuity, time variations, and other factors affect deviations of loudness judgments. AUTHORS.

5638. Mechanics of Sound Conduction and Correction of Conduction Deafness. A. G. Pohlman. *Acoustical Soc. of America, J.* 8. *pp.* 112–117, *Oct.*, 1936.—The part played by the ear drum and the ossicles is discussed and a description given of a case in which a membrane and a hog's bristle replaced them successfully. J. E. R. C.

See also Abstract 5422.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstract 5662.

CONDUCTION AND DISCHARGE IN GASES.

5639. Separation of Light Positive and Negative Ions to Obtain Air Currents with Charges of One Sign. P. Mercier and G. Joyet. *Helv. Phys. Acta,* 9. 7. *pp.* 574–581, 1936. *In French.*—Separation of the positive and negative ions, to obtain an air current with ions of only one sign, is effected very simply by means of an electric field. After removal of dust and heavy ions the air is strongly ionised by a radium preparation in an ionisation chamber and then passed into the separating chamber, where it is subjected to an electric field maintained between two plane parallel grid electrodes. To eliminate the negative ions the field is arranged in the same direction as the air current, when the positive ions are given an increased velocity and the negative ions are, with a sufficiently strong field, driven back to and retained by the entrance grid. To eliminate positive ions the field is reversed. Full details of the actual apparatus employed are given. A. W.

5640. Sensitivity of the Schlieren Chamber. F. Trey. *Arch. f. Elektrot.* 30. *pp.* 683–685, *Oct.* 15, 1936.—The temperature of the canal of a predischarge has not up to the present been measured. In order to obtain an estimate of the temperature rise in the gas due to a predischarge observations were made of such canals by Toepler's streak method and the sensitivity of the method for this case is calculated. From the heating the number of electrons produced by an electron canal can be determined for a given canal diameter. A. W.

5641. Electrode Losses in the Mercury High-Pressure Discharge. W. Elenbaas. *Physica,* 3. *pp.* 947–953, *Nov.,* 1936. *In German.*—The sum of the anode- and kathode-fall V_{A+K} in the high-pressure Hg discharge (oxide-coated electrodes heated by the discharge) is measured by running two discharges of different length in one tube. In this way the vapour pressure in the two discharges is the same. It appears, however, that in the vertical position of the tube, the gradient in the upper discharge is smaller than in the lower one. V_{A+K} is therefore determined by the following two methods: (1) by taking the mean of the values obtained with the longer and the shorter discharge upside; (2) by running the tube in a horizontal position and maintaining the discharge in the axis of the tube by means of a horizontal magnetic field. It follows that V_{A+K} rises with increasing pressure and decreasing current. Oscillographs of the voltage on the two discharges in the case of alternating current, when the deflection per volt is made inversely proportional to the length of the discharge, show that V_{A+K} does not depend much on the phase angle. AUTHOR.

5642. Sputtered Palladium Films. S. Tanaka. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 142, *pp.* 369–406, *Aug.,* 1936. *In English.*—Contaminating materials in the discharge vessel, during sputtering, produced sputtered films, which will either crack or crumple when breathed upon. An attempt is made to relate this behaviour to the dipole moment of the contaminating substance. The effect is obtained with unsaturated hydrocarbons of zero dipole moment, and also with O and N compounds of dipole moment greater than 2×10^{-18} e.s.u. An explanation is put forward on the basis of the electric fields of the contaminating molecules causing the Pd to be deposited with abnormal molecular spacing. When the contamination is removed by its being breathed upon, the metallic film cracks. Crumples are produced by the same contaminations which cause cracking but it seems to be necessary for the contaminating material to be present as a liquid film. Crumples can be obtained without the film being breathed upon if it is thick enough. G. G.

5643. Anode Sputtering and the Deposition of Metallic Film on the Kathode of an X-Ray Tube. S. Sharan. *Indian Journ. Phys.* 10. *pp.* 325–340, *Sept.*, 1936.—The data from the deposition of Cu and Pt films on the kathode of a Hadding's X-ray tube are analysed. It is shown that the deposit on a limited portion near the periphery of the kathode consists only of singly charged particles while the deposit on the rest of the kathode consists of both singly and doubly charged particles. Theories of anode sputtering are briefly discussed. C. J. B. C.

5644. Effect of Irradiation on Arc Striking Potential. W. Fucks and W. Seitz. *Zeits. f. Physik*, 103. 1–2. *pp.* 1–17, 1936.—The lowering of the striking potential in various gases at pressures between 5 and 50 mm. Hg, as a result of irradiation of the discharge space by a Hg arc lamp, is investigated. In contradiction to the generally accepted theory of lowering voltage of the striking, it is found that over a considerable range of gas pressure and radiation intensities, the potential is actually increased. The effect is observed with all the electrode materials (Ag, Cu, Ni, Zn) and gases (A, N_2, He, Air) used, and appears to be of general application. Quantitatively, the effect is shown to be dependent on the nature and pressure of the gas, and on the electrode material. Only the short-wave components of the Hg spectrum produce the changes observed, the longer u.v. waves and visible light being ineffective. J. E. R.

5645. Gas Discharge with Anode Ion Emission and Liberation of Electrons by Positive Ions at the Limiting Surface. K. Mahla. *Zeits. f. techn. Physik*, 17. 10. *pp.* 324–327, 1936.—The liberation of electrons from the kathode of a discharge tube due to the presence of K-ions is examined, the ions being emitted from the heated anode. The results are greatly dependent on the properties of the limiting surface and the influence of the phenomena on gas discharge in general and the production of pseudo high vacuum conditions is investigated. F. C. C.

5646. Glow Discharge at Low Pressure between Coaxial Cylinders in an Axial Magnetic Field. F. M. Penning. *Physica*, 3. *pp.* 873–894, *Nov.*, 1936. *In German.*—Experiments are described concerning the starting voltage and the characteristic of the glow discharge between coaxial cylinders in an axial magnetic field at low gas pressures. With a sufficiently strong magnetic field the electrons leaving the kathode describe cycloidal paths of considerable length before reaching the anode and hence the magnetic field causes an apparent increase of the pressure (up to a factor 1000) and a decrease of the starting voltage V_s (down to a factor 0·01). At very low pressures and large values of the axial field it would be expected that the electrons liberated from the kathode would return to the kathode before collision and be useless for the starting mechanism. Nevertheless, under these conditions with the outer cylinder as kathode, low starting voltages were found, which may be due to roughness of the kathode surface, electron liberation from the curved end parts of the outer cylinder and ionisation by positive ions. With the outer cylinder as anode V_z is much higher, as is also the case when the outer kathode cylinder is left open at both sides. By increase of the angle ϕ between the direction of the magnetic field and the axis of the cylinder, the number of electrons returning to the kathode is diminished, but also the number of ions formed by one electron and in consequence increase of ϕ sometimes causes an increase and sometimes a decrease of V_z. With an open outer cylinder as kathode V_z is lower in an inhomogeneous field than in an homogeneous field. This can be explained by the form of the electron paths in the two cases. In a certain range of values of gas pressure and field (H), V_z was found to have more than one value and the corresponding current-voltage characteristic has two intersections with the V axis. At a somewhat lower value of H, characteristics were found which did not intersect the V-axis at all. These results are discussed. A. W.

5647. Probe Test for Positive Space-Charge. K. G. Emeléus and W. L. Brown. *Phil. Mag.* 22. *pp.* 898–904, *Nov.*, 1936. *Supplement.*—An anomalous form of current-voltage characteristic curve for probes in discharge-tubes is shown to be associated in a number of instances with the presence in the discharge of a pre-existing positive space-charge. When such curves are obtained in other instances, the existence of a positive space-charge may therefore be suspected. AUTHORS.

5648. Excitation of Mercury by Bombardment with Li^+, Na^+, K^+, Rb^+, Cs^+. O. Henle and W. Maurer. *Phys. Zeits.* 37. *pp.* 659–661, *Sept.* 15, 1936.—The excitation of the Hg was the same for all five alkali metals and the voltage was under 500 V. For Li^+, Na^+-Hg, and Cs^+-N_2 strong arc lines were observed. Possibly there are no arc lines when there is no secondary process. Li^+ and Na^+ give no spark lines below 9000 V; with this voltage K II and Rb II are weakly indicated and Cs II lines appear. The results are discussed. W. R. A.

5649. Mass-Spectrographic Analysis of the Ions Produced in HCl under Electron Impact. A. O. Nier and E. E. Hanson. *Phys. Rev.* 50. *pp.* 722–726, *Oct.* 15, 1936.—An investigation has been made by a mass spectrograph of the ions formed in HCl under electron impact. The following ions were observed: HCl^+, HCl^{2+}, H^+, Cl^+, Cl^{2+}, Cl^{3+}, Cl^{4+}, Cl^{5+}, and Cl^-. When He and Ne were used as calibrating gases, the following appearance potentials were determined: HCl^+, $12\cdot9 \pm 0\cdot2$ volts; HCl^{2+}, $35\cdot7 \pm 1\cdot0$; H^+, $18\cdot6 \pm 0\cdot3$ and $28\cdot4 \pm 0\cdot3$; Cl^+, $17\cdot2 \pm 0\cdot5$ and $21\cdot2 \pm 0\cdot5$; Cl^{2+}, $45\cdot7 \pm 0\cdot3$; Cl^{3+}, approximately 160; Cl^-, approximately $1\cdot6$ volts. The efficiency of ionisation curves were of the usual form. From the ratio of the peak heights of HCl^{35} to HCl^{37} the abundance ratio Cl^{35}/Cl^{37} was found to be $3\cdot07 \pm 0\cdot03$. Cl^{39} if present was less than 1/20,000 of Cl^{35}. AUTHORS.

5650. Electron Affinities of He, Li, and F. Ta-You Wu. *Phil. Mag.* 22. *pp.* 837–846, *Nov.*, 1936.—The approximate calculation of the electron affinities of the halogens with the Thomas-Fermi potential is shown to be unsatisfactory. The variational method of wave mechanics is applied to the calculation of the electron affinity of Li in the normal state and that of He in the normal and excited states. Corrections to the calculated values of different energy states are made by considering the discrepancy between the calculated and the observed values of similar states of the iso-electronic series of atoms and ions. The result is that Li in the normal state has an electron affinity of about 0·54 V.; He in the normal state has no electron affinity; in the $1s\,2s\,{}^3S$ state the electron affinity is probably very small; while in the doubly excited state $2s^2\,{}^1S$ it is about 33 V. The method of Bacher and Goudsmit is applied to the calculation of the electron affinity of F from the data of Edlén. The result is about 4·1 V. The paper gives the wave functions for the states $1s^2\,2s$ of Li, Be^+, B^{++}; $1s^2\,2s^2$ for Li^-, Be, B^+, C^{++}; and $1s\,2s^2$ for He^-. These functions and the Bacher-Goudsmit relations for $s^2\,p^6\,{}^1S$ and $sp^6\,{}^2S$ may be useful for other purposes. AUTHOR.

5651. Hydroxyl Radicals in the Electric Discharge in Water Vapour. V. Kondratjew and M. Ziskin. *Acta Physicochimica*, 5. 3. *pp.* 301–324, 1936. *In English*.—The sensitivity of the optical method of measuring small concentrations of gases (by their absorption spectra) may be increased by substituting a line source for the usual continuous source of light. This method is now used for the study of OH radicals in the electric discharge. Full experimental details are included. The temperature of the radicals determined spectroscopically is found to be about 100° C. with discharge currents of the order of 100 *m*A. On the assumption that the absorption coefficient of the OH is of the same order of magnitude as that of the Na atom (for the D lines), a calculation is made of the concentration of the OH radicals. With different discharge currents the concentrations correspond to partial pressures of the order 10^{-5} to 10^{-4} mm. It is shown that the relation between the concentration of OH radicals ($\bar{n}$) and the time (t) elapsing from the moment of stopping the discharge, the strength of the discharge current (I) and the vapour pressure (p) of the water, satisfy quantitatively the law $\bar{n}(t) = a\sqrt{p}\sqrt{I}/(1 + b\sqrt{p}\sqrt{I}t)$, based on the assumption that the OH radicals are destroyed by the process $2OH \rightarrow H_2 + O_2$. This process probably corresponds to the actual mechanism of the phenomenon, and its calculated efficiency is of the order of 0·01. H. H. Ho.

***5652. Relay for a Radiation Integrator. T. B. Lane.** *Journ. Sci. Instruments*, 13. *pp.* 364–366, *Nov.*, 1936.—A radiation integrator is described in which the voltage variation across a condenser produced by leading ionisation currents into it, controls a thyratron relay. When the arc of the thyratron strikes, the event is recorded on a counter, and the condenser is discharged, thus resetting the apparatus to receive a fresh charge. Methods of reducing instability of the thyratron due to h.f. disturbances are discussed. AUTHOR.

***5653. Mechanical Counter for Electrical Impulses. J. L. Tuck.** *Journ. Sci. Instruments*. 13. *pp.* 366–367, *Nov.*, 1936.—The counter uses a loud-speaker movement in conjunction with a stop-watch mechanism. It has a greater resolving power than a telephone call counter, and its lower inductance makes it very suitable for operation from a thyratron. AUTHOR.

***5654. Scale of Eight Impulse Counter. W. G. Shepherd and R. O. Haxby.** *Rev. Sci. Instruments*, 7. *pp.* 425–426, *Nov.*, 1936.—A modified Wynn-Williams scale of eight counting circuit is described which employs type 885 argon filled tubes. These tubes have the advantages of a very small deionisation time, characteristics independent of temperature and low cost. AUTHORS.

***5655. Starting Potentials of Geiger-Müller Counters. C. L. Haines.** *Rev. Sci. Instruments*, 7. *pp.* 411–413, *Nov.*, 1936.—The starting potential of Geiger-Müller counters filled with various pressures of air, He, H_2, O_2, A and two A-O_2 mixtures have been accurately determined for counters with oxidised Cu cylinders 1·0 cm. in dia., and bare W wires 0·0075 cm., 0·0125 cm., and 0·025 cm. dia. Except at low pressures, Werner's equation fits the results fairly well, when suitable constants are chosen, for all these gases except He. At low pressures, the starting potentials *diminish* as the size of the wire increases. AUTHOR.

***5656. Amplifier for Point and Tube Counters. W. Schmitz.** *Zeits. f. techn. Physik,* 17. 10. *pp.* 323–324, 1936.—For use with point and tube counters an amplifier is described which, by a form of back coupling, allows a rate of counting limited only by the mechanical properties of the associated count register. F. C. C.

***5657. Operation of Geiger-Müller Counters. G. Medicus.** *Zeits. f. Physik,* 103. 1–2. *pp.* 76–112, 1936.—Experiments are conducted on two tube counters with Cu kathodes in Pd tubes sealed in a glass tube filled with H_2. One counter showed a change in its properties and this was attributed to moisture on the glass walls. The other counter was constant. Statistics of the change were obtained and the observations were in good agreement with theory based on the supposition of an exponentially falling probability of change. The time constant of the changing counter varied by as much as 0·74 sec. Dependence of change on temperature, light and the presence of mercury vapour were also examined. F. C. C.

***5658. Spark Counter for Counting Corpuscles and Photons. H. Greinacher.** *Helv. Phys. Acta,* 9. 7. *pp.* 590–595, 1936. *In German.*—The spark counter, based on the discharge between a charged point and a plate during the passage of an ionising particle near the gap, is shown to be satisfactory when used in conjunction with a ballistic galvanometer, for the registration of α- and β-particles and photoelectrons. A convenient check is provided using purely optical registration by photographing the spark on a moving film. F. C. C.

***5659. Stereo-Comparator for Work with the Cloud Chamber. L. Grošev, N. Dobrotin and J. Frank.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 3. 6. *pp.* 289–290, 1936. *In English.*—This method of using a stereo-comparator is a variation of that of Nuttall and Williams. The negative is placed in the stereoscopic camera and an image of a pointer is also obtained by means of the lenses of the camera. This pointer can be moved by three vernier screws, mutually perpendicular to each other. It can thus be made to coincide with any point of the track, the coordinates of which can thus be read off ; in this way the whole track may be plotted out. A simple adaptation to the measurement of angles is described. The main advantage claimed for the apparatus is that the exact dimensions of the track are measured and no knowledge of the constants of the instrument is required. G. G.

***5660. Continuously Active Cloud Chamber. R. E. Vollrath.** *Rev. Sci. Instruments,* 7. *pp.* 409–410, *Nov.,* 1936.—When HCl vapour and water vapour are allowed to diffuse together the mixture obtained is supersaturated with respect to both components. An ionising particle passing through the mixture causes a string of droplets to form by condensation of the supersaturated vapours on the ions. Utilising this chemical method of producing supersaturated vapours a very simple type of continuously active cloud chamber without moving parts has been developed. The cloud chamber in its present stage of development is not suitable for photographic recording, but is useful for demonstration purposes. Cosmic-ray tracks can be seen with ease by visual observation. AUTHOR.

See also Abstracts 5333, 5533, 5534, 5576, 5577, 5681, 5708.

CONDUCTION IN SOLIDS AND LIQUIDS.

5661. Electrophysics of Solid Bodies. A. Smekal. *Die Physik,* 4. 4. *pp.* 173–192, 1936.—A critical survey of papers dealing with electronic conduction in non-metallics, which have appeared between 1927 and July 1, 1936 [see also Abstract 2339 (1936)], under the following heads: (9) Electronic conduction in general. (10) Non-metallic electronic conduction in general. (11) Nature of conduction in, and chemical production of, semiconductors. (12) Temperature dependence of non-metallic electronic conduction. (13) Independent electronic conduction. (14) Mechanism of non-metallic electronic conduction. (15) Consequences of the properties of non-metallic electronic conductivity. D. R. H.

***5662. New A.C. Zero Indicator. C. K. Gieringer.** *Rev. Sci. Instruments,* 7. *pp.* 414–419, *Nov.,* 1936.—Detection of small a.c. voltages over a wide range of frequencies with sensitivity comparable with d.c. necessitates methods, equipment and technique far in advance of that required for the equivalent d.c. measurements. The portable d.c. meter offers the ultimate in simplicity, compactness and ruggedness for use as a d.c. zero indicator. A simple method of detecting a.c. voltages is to use a d.c. meter in conjunction with a rectifier, of which perhaps the metallic thin film rectifier is the best to date from the standpoint of simplicity, ruggedness and compactness. The d.c. meter and rectifier as conventionally used are unreliable for zero indications because of inherent characteristics of the rectifier. AUTHOR.

5663. Electrical Conductivity and Phase-Diagram of Pd-Cr Alloys. G. Grube and R. Knabe. *Zeits. f. Elektrochem.* 42. *pp.* 793–804, *Nov.,* 1936.—Employing thermal, microscopic and X-ray technique on the conductivity method, the phase-diagram of the Pd-Cr binary alloys has been worked out. The intermediate phase Pd_2Cr_3 enters the system. Brinell hardness measurements indicate the maximum hardness occurring with the Pd_2Cr_3 combination. The specific resistance of pure Cr sintered in H_2 is measured. Cr_2O_3 is soluble in molten Cr. While the melting point of pure Cr was found to be 1890 ± 10° C., oxide-bearing Cr began to solidify at 1770–1790° C. J. E. B.

5664. Electrical Conductivity and Phase Diagram of Pd-Mn Alloys. G. Grube, K. Bayer and H. Bumm. *Zeits. f. Elektrochem.* 42. *pp.* 805–815, *Nov.,* 1936.—It is known that α and β-Mn are very brittle and will scratch glass, while, on the contrary, γ-Mn is soft. The Brinell hardness of the Pd-Mn group of alloys was determined for tempered, untempered and chilled specimens. The alloys containing up to 25% Mn are easily worked and cold-rolled. From 40 % Mn, upwards, the alloys are brittle and difficult to work. The very hard alloys with high Mn content are quenched at 1000° C. and are soft and workable. They can be hardened by tempering. J. E. B.

5665. H.F. Conductivity of Colloidal Electrolytes. G. Schmid and A. V. Erkkila. *Zeits. f. Elektrochem.* 42. *pp.* 781–785, *Nov.,* 1936.—The increase of h.f. conductivity ($\lambda = 3 \cdot 6$ m.) is much greater for colloidal than for crystalloidal solutions. For alkaline earth caesinates the effect is about twice that for alkali caesinates, and depends only on kation

valency. Caesin content has little effect on conductivity either at normal or at high frequency. In general the alkali caesinates are the better conductors. Sr caesinate shows an abnormally large h.f. effect. To explain the results it is assumed that complex ions are formed, and that these do not transport at normal frequencies. [See Abstract 5248 (1936).]
D. R. H.

5666. Electrical Investigation of Oxide Semiconductors. W. Hartmann. *Zeits. f. Physik,* 102. 11–12. *pp.* 709–733, 1936.—An investigation into the nature of the electrical conductivity of oxide semiconductors is described in detail together with the necessary experimental procedure and precautions. Graphs are given showing in all cases a linear relation between log σ and $1/T^\circ$ (where σ = specific conductivity and T = absolute temperature) for Al_2O_3, Ta_2O_5, UO_2, and CuO. In all cases log σ increases with $1/T^\circ$. In addition the Hall constant R is measured for UO_2 and CuO. This also shows a linear relation between log R and $1/T^\circ$ K. The temperature range of the latter experiments is between 20° and −66° C. R. L.

See also Abstracts **5579, 5586, 5656, 5672, 5691.**

DIELECTRICS AND CAPACITANCE.

5667. Molecular Dipole Moments from Data of Electrical Stern-Gerlach Experiments. R. G. J. Fraser and J. V. Hughes. *J. Chem. Phys.* 4. *pp.* 730–731, *Nov.,* 1936.—Rodebush, Murray and Bixler [see Abstract 3317 (1936)] have reported measurements of the electrical dipole moments of the alkali halides by the molecular beam method, which gave values for KCl and KI much greater than those obtained by Scheffers, also by a beam method. These discrepancies are now reviewed, and the geometry of the apparatus taken into account, but still remain greater than the probable experimental error. Association at the higher temperatures and pressures used by Scheffers may account for them. Nevertheless it may be significant that Estermann and Fraser obtained a high value for μ (HCl) using essentially the same method. Errors, arising from an application of Rabi's formulæ in cases where the angle of incidence is small may lead to too small values of the moment, but a careful re-examination of the theory of the Rabi field has not revealed any unsuspected source of error. H. H. Ho.

5668. Relation of Dielectric Constant of Mercury Vapour to Density at Different Temperatures. P. Wüsthoff. *Ann. d. Physik,* 27. 4. *pp.* 312–328, *Oct.,* 1936.—The dielectric constant of Hg vapour is measured at 401, 410, 445, 470° C.; also at 455° C. up to a pressure of 3 atm., by a h.f. oscillation method. The gas condenser is fully described and the pressure is measured in the vessel by a compensation device. The apparatus is first calibrated by pure N_2 of which the dielectric constant is taken as 1·000581 at N.T.P. Since the presence of diatomic molecules in the vapour and the deviation from Boyle's law can be neglected, the density d is calculated from van Laar's equation $d = 2{\cdot}44\ p/T$, where p is the pressure and T the absolute temperature. The Clausius-Mossotti formula $(\epsilon - 1)/(\epsilon + 2)/d$ = constant (ϵ is dielectric constant), is found to be true and the atomic radius estimated from this is in good agreement with other results. The square of the refractive index for a wave-length 0·690 μ is considerably greater than the dielectric constant for which the value $\epsilon - 1 = 170{\cdot}10^{-5} \pm 4\,\%$ at N.T.P. is found.
H. M. B.

5669. Effect of Illumination on the Dielectric Constant of Silver Bromide. J. Martens. *Zeits. f. Physik*, 103. 3–4. *pp.* 217–236, 1936.—The effect of illuminating AgBr has been studied by observing the change in the dielectric constant. From a knowledge of the quantum efficiency a probable interpretation is advanced. W. R. A.

5670. Liberation of Electrical Energy during the Fusion of Electrets. H. Frei and G. Groetzinger. *Phys. Zeits.* 37. *pp.* 720–724, *Oct.* 15, 1936.—It is shown that during the fusion of an electret (made from beeswax) which no longer produces an electric field, a current flows between two electrodes introduced into it [see also Abstract 4767 (1936)]. If the substance from which the electret has been prepared, had been polarised in the solid state, then the current was essentially weaker. The total quantity of electricity obtained during the fusion is independent of the time which has passed between the production (polarisation) and fusion (depolarisation). If paraffin, a non-polar substance, be exposed to an electrical field during solidification or in the solid state, then in both cases, for equal times of exposure, are equal amounts of electricity afforded during the fusion. The experiments indicate that the assumption of an electrical polarisation in the electret which is independent of the time is fulfilled when this polarisation produces no electrical field. Since the amount of electricity during the fusion is proportional to the field strength up to 13000 V./cm., a linear relationship is indicated between the permanent polarisation in the electret and the field strength. H. H. Ho.

5671. Electrical Saturation in Pure Liquids and their Mixtures. A. Piekara and B. Piekara. *Comptes Rendus*, 203. *pp.* 852–854, *Nov.* 3, 1936.—An electric field when applied to a polar liquid diminishes its dielectric constant. The diminution found, however, is much smaller than that given by the Debye theory, and this has been ascribed to dipolar association. In order to study the rôle of association for the case of electrical saturation, the authors have examined the influence of the electric field on the dielectric constants of mixtures of nitrobenzene and benzene. A resonance method was employed, which eliminated the influence of liquid conductivity and its change through the action of an electric field. The applied field was 70,000 V/cm. at a temperature of −21°, and the curve connecting the dielectric constant with the field shows a zero effect for pure benzene, a negative effect (diminution in dielectric constant) for small concentrations which increases to a maximum at about 95 %, then diminishes and finally attains a positive value of 75×10^{-4} for pure nitrobenzene. The association hypothesis does not explain the change of origin. It is suggested that the observed phenomenon is the resultant of two effects of opposite origin, *viz.*, a negative effect which, on the Debye theory, is due to electrical saturation and a positive effect of a different origin. H. H. Ho.

5672. H.F. Absorption and Dispersion Measurements on Glycerin Solutions. W. Schmacks. *Ann. d. Physik*, 27. 4. *pp.* 285–298, *Oct.*, 1936.—Describes measurements of anomalous absorption and dispersion on glycerin and solutions of $MgSO_4$ in glycerin at wave-lengths of from 10 to 20 m. A maximum of conductivity is observed at about 14 m. wave-length, the value being dependent on the concentration. E. R.

5673. Chemical Kinetics of Dielectric Relaxation. F. C. Frank. *Faraday Soc., Trans.* 32. *pp.* 1634–1647, *Nov.*, 1936.—The theory of unimolecular chemical reaction velocities is applied to the process of change of orientation of a polar molecule in a material showing dielectric loss and dispersion. The requisite analysis of experimental data is explained. Experimental results for three different types of physical system are considered: (1) Ice, (2) Solid solutions of polar substances in paraffin wax, (3) A polar organic glass at the top of its softening range ("permitol"). Type (1), and apparently cases in (2) at low temperature, present fairly normal unimolecular reactions; the rest present very fast reactions, as though activation involved many degrees of freedom. This is thought to be consistent with their physical nature. **Author.**

See also Abstracts 5449, 5681.

ELECTROCHEMISTRY.

***5674. Standard Cell of Low E.M.F. W. Gremmer.** *Phys. Zeits.* 37. *pp.* 697–699, *Oct.* 15, 1936. *From the Reichsanstalt.*—Standard cells having e.m.f.s of the order of 45 mV may be made from Cd amalgams, one pole consisting of fluid and the other of solid amalgam with an electrolyte of $CdSO_4$ solution. The concentrations of the amalgams for a typical cell are given. A number of such cells were first made in 1934 and a brief description is given of tests which have been carried out on them continuously since that date. The tests show that for the first four months the e.m.f. is liable to fluctuation, but that after that period it becomes steady. The e.m.f. is 0·04463 to 0·04470 V at 18° C. and the temperature coefficient −0·00026 V/°C. The concentration of the electrolyte seems to have no effect on the e.m.f. and the cells quickly recover from polarisation. H. J. H. S.

5675. Activity Coefficients from Concentration Cell Potentials. T. Shedlovsky and D. A. MacInnes. *Am. Chem. Soc., J.* 58. *pp.* 1970–1972, *Oct.*, 1936.—Accurate measurements of HCl concentration cells, with liquid junction, are obtained, from which activity coefficients of the ions of the acid are computed. The results are shown to be in close agreement with those obtained using cells without liquid junctions. The activity coefficients are found to follow the Debye-Hückel theory with a "distance of closest approach" of 5·62 Å, up to about 0·04 *N.* Accurate agreement with the Hückel equation is observed throughout the concentration range of 0·003 to 0·1 *N.* [See Abstract 3987 (1935).] **Authors.**

5676. Thermodynamics and Electrophysics of Liquid Electrolytic Solutions. Part I. H. Falkenhagen. *Die Physik*, 4. 4. *pp.* 145–172, 1936.—An earlier monograph by the author describes the development of the investigation of electrolytes, and the mathematical theory is brought into line with the experimental methods and the results obtained by them. In the present paper the earlier work is reviewed in the light of present physical theory. The investigations which have been carried out since 1934 are included in the review. F. J. B.

5677. Potential of Platinum in Solutions of Silver Salts. A. Obručeva and A. Frumkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 4. 1. *pp.* 11–13, 1936. *In German.*—The Pt electrode in solutions of Ag salts is shown to take up the potential of Ag. When the Pt electrode has taken up the reversible Ag potential fine needle crystals are found on the Pt electrode, especially when platinised. $AgNO_3$ solutions lose their ability to confer the Ag potential on Pt, but they can be regenerated by warming to 50° C. with Ag powder, or by strongly illuminating the solution for several hours. F. J. B.

5678. Zinc and Zinc Amalgam Electrodes. W. J. Clayton and W. C. Vosburgh. *Am. Chem. Soc., J.* 58. *pp.* 2093–2096, *Nov.*, 1936.—The e.m.f. of the cell Zn(s)/Zn^{++}/Zn (satd. amalgam) is zero. The symbol Zn(s) may be understood to stand for either a pure zinc electrode or a superficially amalgamated zinc electrode, these two having the same electrode potential. AUTHORS.

5679. Energy Levels in Electrochemistry. Part II. W. D. Bancroft and J. E. Magoffin. *Am. Chem. Soc., J.* 58. *pp.* 2187–2189, *Nov.*, 1936.—The general results of this paper are: (1) Since the reduction of cystine to cysteine is not strictly reversible, the e.m.f. of a cysteine-cystine electrode is theoretically a function of the temperature, the pH and the concentration of cysteine but not a function of the concentration of cystine. (2) If an electron transfer between an inert metal and an oxidisable or reducible substance involves passing through an energy hump under the conditions of the experiment, a reducing potential or oxidising potential characteristic of that substance will not be set up; otherwise, it will. (3) "Resting" bacteria are catalytic agents for some systems and a bacterial chemistry may be based on this property. [For Part I see Abstract 1336 (1936).] AUTHORS.

See also Abstracts 5347, 5441, 5612, 5615.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATION.

5680. Oscillatory Motion of the Electron on Dirac's Theory. G. Wataghin. *Ricerca Scientifica,* 2. *pp.* 333–334, *Sept.*, 1936.—Mathematical considerations of the interaction between the electromagnetic field and the oscillatory motion of the electron on Dirac's theory. F. C. C.

5681. Distribution of Velocities of Electrons in a Magnetic Field. T. V. Ionescu and C. Mihul. *Soc. Române Fiz., Bul.* 37. 66. *pp.* 3–6, 1936. *In French.*—The authors, using the Langmuir probe-wire method have shown by measuring the conductivity and dieletric constant [see Abstract 1239 (1935)] that electrons travelling in a discharge tube at pressures of 10^{-4} mm. Hg are divided into several groups of different discreet velocities when this tube is placed in a magnetic field parallel to its axis and between the plates of a condenser in a resonance circuit. The introduction of a magnetic field increases the current and causes the appearance of certain luminous phenomena. R. L.

5682. Electron Diffraction Analysis of Organic Films. S. Pinsker and L. Tatarinowa. *Acta Physiochimica,* 5. 3. *pp.* 381–390, 1936. *In German.*—"Extra" rings and spots are observed in electron diffraction patterns, and it is shown that these diffractions are identical with those of paraffin. An orthorhombic structure is assumed and the estimated parameters are $a = 7\cdot46$, $b = 4\cdot97$, $c = 2\cdot5$ Å, in good agreement with the X-ray results for paraffin. Further, structure amplitude considerations predict an intensity distribution coinciding with that observed in the diffraction patterns. The observed spacings are also compared with the theoretical values for cellulose, but comparison with cellulose derivatives is not possible owing to lack of published results on the subject. Where possible, the spacings for the impurity are referred to the known lattice constants of the specimen material. The orientations of paraffin are investigated and a tendency for the basal *ab* plane to lie parallel to the plane of the film is found. A. G. Q.

5683. Diffraction of Electrons by Molybdenite. G. I. Finch and H. Wilman. *Faraday Soc., Trans.* 32. *pp.* 1539–1556, *Nov.,* 1936.—The diffraction of electrons by thin stationary and rotating molybdenite crystals is studied. In addition to those to be anticipated from the known structure, many anomalous diffractions are recorded and explained in terms of the lattice limitation theory, as first applied to the graphite spectra. Single crystals of only a few lattice layers in thickness, some free from distortion and others exhibiting only simple uniaxial curvature, are obtained and yield on rotation the two-dimensional cross-grating effect of continuous diffraction lines. It is shown that such lines, and tolerance effects in general, decrease in intensity with increasing crystal thickness. Such tolerance effects are also recorded with mica. As with X-rays, the axial ratio of molybdenite is found to be $3\cdot90_4$, from which it is concluded that c is independent of crystal thickness. The general theory of the loci of the diffractions from rotating undistorted and from stationary curved molybdenite crystals is developed and shown to be in agreement with experiment. AUTHORS.

5684. Electron Beams through Narrow Slits. W. McFarlane. *Phil. Mag.* 22. *pp.* 801–810, *Nov.,* 1936.—It is found that when a beam of electrons from a straight tungsten filament is accelerated towards an anode in a high vacuum and passed through a narrow rectangular slit with a width of the order of 0·1 mm., the emergent beam exhibits a band-like structure with bands falling inside the geometrical shadow of the slit. The patterns are reminiscent of diffraction phenomena, but are shown to be due to a distribution of positive and negative electric charges on the slit-edges. The source of these charges is at present undetermined, but they are probably related to minute irregularities on the edges. N. M. B.

5685. Liberation Depth of Secondary Electrons. H. Bruining. *Physica,* 3. *pp.* 1046–1052, *Nov.,* 1936. *In English.*—An explanation is given of the discrepancy in the results hitherto published. Thus, with a smooth C target the number of secondary electrons increases with increasing angle of incidence whilst little change is observed with a rough surface because the angle of incidence in this case is not well defined. The increased emission with a smooth target is attributed to liberation of secondary electrons at a smaller depth. The maximum appearing in the curve showing the relation between secondary emission and velocity of the primary electrons is explained, and the depth of origin for the secondary electrons emitted by a Ni target bombarded with 500 V electrons is estimated to be 30 Å. A. G. Q.

5686. Resolving Power in Electronic Microscopy. L. Marton. *Physica,* 3. *pp.* 959–967, *Nov.,* 1936. *In French.*—A distinction is drawn between " surface resolving power " and " depth resolving power." The latter can be calculated in first approximation by the aid of a simple hypothesis about the smallest observable constrast and the mechanism of image formation. AUTHOR.

See also Abstracts 5328, 5329, 5330, 5331, 5344, 5356, 5500, 5538, 5540, 5577, 5688.

ELECTROSTATICS.

5687. Special Problem in the Theory of Potential. W. Wirtinger. *Akad. Wiss. Wien, Ber.* 145. 2a. 1–2. *pp.* 95–100, 1936.—Two infinitely extended plane metal plates at a distance a apart are both earthed ; in the space between the two is placed a small test body having the charge e at a distance h from one of the plates. The field relations are discussed and a new solution is obtained. J. J. S.

5688. Electrostatic Energy as the Mutual Energy of Vibrating Particles. E. T. Jones. *Phil. Mag.* 22. *pp.* 921–938, *Nov.*, 1936. *Supplement.*—In a previous paper [see Abstract 1353 (1936)] the hypothesis was examined that the electrostatic attraction or repulsion of two electrons is the result of the interaction of their natural vibrations by which they are caused to vibrate with a common frequency, different from their undisturbed frequency, as a coupled system. The theory was applied to systems consisting of small numbers of electrons; it is now applied to systems of 4 and 8 electrons and to the problem of two concentric spheres having equal numbers of electrons distributed over them. In all the systems discussed each electron may be replaced by a sub-group of electrons, the linear dimensions of the sub-groups being small compared with the distances between them. Provided the sub-groups in each group are all similar and of simple regular form, *e.g.*, spheres or cubes, the frequency and vibrational energy of the system may be calculated by the method illustrated in this paper. C. J. B. C.

See also Abstract 5670.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

5689. Hall Effect in Alloys of Sb-Te and Sb-Ag. E. van Aubel. *Comptes Rendus*, 203. *pp.* 614–615, *Oct.* 5, 1936.—The Hall effect in a number of Sb-Te and Sb-Ag alloys has been measured to examine the relation between this and the thermoelectric effect. The Hall effect in the Sb-Te alloy is very much less than that of the Te alone. The thermoelectric effect is also very much lower. In the case of the Sb-Ag alloy a kink in the curve indicates the formation of a compound Ag_3Sb. J. E. R. C.

See also Abstract 5666.

MAGNETISM AND ELECTROMAGNETISM.

5690. Most Suitable Dimensions for Permanent Magnet Ellipsoids. H. Neumann and K. Warmuth. *E.N.T.* 13. *pp.* 295–309, *Sept.*, 1936.—The external field of an ellipsoidal permanent magnet is calculated for the two Gaussian principal planes and is exhibited graphically as a function of dimension ratio (D.R.) and distance. It is shown that, for a material of given coercivity and remanence, there is a certain D.R. which gives a maximum external field. A number of graphs are prepared from which this ratio may be read off for a material of known magnetic properties and for a given distance and volume in order to give a maximum field in the principal planes. H. J. H. S.

5691. Conductivity and Permeability of Iron Wires. E. Rath. *Arch. f. Elektrot.* 30. *pp.* 651–662, *Oct.* 15, 1936.—Electric and magnetic skin-effects in iron wires or tubes involve circumferential values of permeability and conductivity as well as the longitudinal values measured by the usual methods. A mathematical analysis shows how the 4 constants may be deduced from l.f. bridge measurements of the effective resistance and inductance of a straight wire and of a toroidal coil wound on a circular core of the same wire. Sources of error are fully discussed, and checks on the results are described, which indicate an accuracy of about 2 %. Experimental results for commercial irons and steels and a Ni-Fe alloy, both hard-drawn and annealed, show that, except in annealed electrolytic iron, the difference between circumferential and longitudinal values does not exceed 20 % and is thus of little practical importance. C. E. W.

5692. Initial Susceptibility in Presence of Transverse Magnetisation. A. Perrier and H. Favez. *Helv. Phys. Acta*, 9. 7. *pp.* 563–573, 1936. *In French.*—The effect of transverse fields and residual magnetism on the longitudinal magnetisation in weak fields of a soft steel specimen is investigated. Curves connecting longitudinal κ and H for given transverse magnetisations are found to be approximately represented by $\kappa = a + b\mathrm{H}$ with a sharp discontinuity in the values of a and b (κ being continuous) at $\mathrm{H} = 0{\cdot}3$ oersted. The effect of transverse remanent magnetism is to increase the reversible magnetisation (measured by a) and to decrease the irreversible magnetisation (measured by b) with an apparent exception in the case of a below 0·3 oe. This general result is consistent with the theory of simultaneous action of mechanical and magnetic couplings between elementary, spontaneously magnetised groups during the process of magnetisation. C. E. W.

5693. Diamagnetism and Particle Size. H. Lessheim. *Current Science*, 5. *pp.* 119–127, *Sept.*, 1936.—The investigation of the diamagnetic susceptibility of small particles obtained by colloidalisation or cold-working has shown that apparently the susceptibility depends on the size of the particles. The paper contains a critical survey of the whole subject, and the conclusions which may at present be drawn are: The theoretical considerations put forward by S. R. Rao do not support this view that the surface area of the particle is the immediate deciding factor. The effect of increased surface is far too small to account for the decreased diamagnetism. The available evidence is in complete agreement with Bhatnagar's view that the increased surface may only be effective in facilitating hydration, oxidation and other processes. From this point of view the decrease of diamagnetism is solely an impurity effect. [See also Abstract 2393 (1936).] G. E. A.

5694. Electromagnetic Field Due to a Punctiform Source. R. Einaudi. *Accad. Sci. Torino, Atti*, 71. *Disp.* 3a. *pp.* 443–451, *May–Oct.*, 1936.—A new representation is given of the electromagnetic field due to a pointed source which under certain aspects seems a much more advantageous method than that by means of multipoles. Whilst the classical method of multipoles (which is summarised in this paper) expresses the electromagnetic field from a punctiform source as superposition of electromagnetic fields of the multipole *linearly dependent* amongst themselves, the new method of representation allows expression of the total electromagnetic field from such a source by superposition of infinite electromagnetic fields *linearly independent* between themselves, each one of which depends on an arbitrary vector that represents in a certain kind of way the condition of excitation of the source. Moreover the new method has a particularly expressive form which lends itself well to numerical transformation. J. J. S.

***5695. Method of Producing Uniform Magnetic Field. R. H. Bacon.** *Rev. Sci. Instruments*, 7. *pp.* 423–425, *Nov.*, 1936.—Describes the design of a pair of coils to give a uniform magnetic field, when their size and shape cannot be freely chosen. The cross-section of the coils is divided into two or more regions, and the ampere-turns in each region are so adjusted that the variations in the field due to one region neutralise those in the field due to the remaining regions. A simplified method of calculating the field-strength at various points is described, which indicates the uniformity to be expected (though not the absolute magnitudes) with high accuracy. C. E. W.

See also Abstracts 5382, 5383, 5402, 5449.

MEDICAL RADIOLOGY AND ELECTROLOGY.

5696. Non-Thermal Effects of Electric Oscillations on Colloids. W. Krasny-Ergen. *Hochfrequenztechn. u. Elektroakustik*, 48. *pp.* 126–133, *Oct.*, 1936.—A theoretical discussion is given of the behaviour of colloids in alternating electric fields, particular attention being given to ponderometric forces (induction forces) which arise between the dipoles and multipoles formed in the dispersed particles by the action of the field. The theory given to explain known experimental results assumes that in a field of constant direction the particles form aggregates resembling strings of pearls. The effect of the induction forces on the sedimentation velocity is investigated qualitatively and found to be not very large, but not negligible. Different conditions affecting the sedimentation velocity are discussed and also the possibility of affecting the sedimentation equilibrium. The effects dealt with are dependent on the direction of the electric field and hence on whether the field is a rotational field, a field of constant direction, or a combination of the two. It is found that rotating fields occur spontaneously for certain frequencies and that these frequencies lie in the short- and ultra-short-wave region used in biological research. [See also Abstract 4727 (1935).] A. W.

OSCILLATIONS.

5697. Production and Use of Short Electrical Impulses. R. C. Colwell, A. W. Friend and N. I. Hall. *Rev. Sci. Instruments*, 7. *pp.* 420–422, *Nov.*, 1936.—Brief descriptions are first given of mechanical methods of obtaining the short electrical impulses required for investigating ionospheric layer heights. In these the pulse duration is of the order of 100 to 500 μs. A good electrical arrangement consists of a condenser which charges from a power supply through a resistor at a rate determined by the resistor condenser time constant and is discharged due to a synchronous control circuit acting on the grid of a Hg-vapour triode. The discharge current passes through a second resistor across which a high voltage is developed and used in the grid circuit of a r.f. amplifier to oppose the grid bias, thus causing a pulse of very short duration to be emitted by the amplifier. With such an arrangement a reliable and uniform pulse output can be obtained with d.c. pulses of 500 V (peak) or more, and a time duration of 10 μs or less. In a modification of this arrangement the condenser charging resistor is replaced by a diode which allows charging only on the positive alternation of the exciting a.c. voltage. The grid of the Hg-vapour triode is operated 180° out of phase with the charging potential so that firing takes place on the negative charging alternation when the diode valve is not conducting. With the very short, sharp pulses produced by this apparatus a new low-lying region has been detected in the ionosphere. This region varies in height from 2 to 12 km. in summer and may rise to from 10 to 30 km. in winter. It has been suggested that this should be called the C-region. The region above this (35 to 60 km.) has been referred to as the absorbing region D, although it has considerable reflecting power. A. W.

5698. Velocity of Radio Waves. R. C. Colwell. *Elect. J.* 33. *p.* 467, *Oct.*, 1936.—The use of 60-cycle power lines for synchronising radio-transmitting and receiving equipment at two distant stations is making possible the measurement of the velocity of propagation of radio waves. The velocity of propagation is being determined by measuring the time required for a very short r.f. pulse to travel from A (base station) to B (field station) and back to A. This method of velocity measurement is an adaptation of the method of Breit and Tuve for determining the height of the ionosphere. It differs in that a second station, a known distance from the base station, takes the place of an ionised layer as the means of reflecting the waves back to the base station. Preliminary tests indicate that the ground wave is propagated with about 2/3rds the velocity of light. J. E. B.

5699. Velocity of Radio Waves. R. C. Colwell, N. I. Hall and L. R. Hill. *Frank. Inst., J.* 222. *pp.* 551–562, *Nov.*, 1936.—A radio station " A " sends out 60 short pulses/sec.; another station " B " at a distance of 20 km. is also sending out 60 pulses/sec. By means of a phase shifter, the operator at B can send his pulses back to " A " at the exact instant of reception. Hence the station " B " acts as a reflector for the pulses. The operator at " B " sets his pulses in coincidence with those from " A " with the aid of an oscilloscope having a 60-cycle sweep. The operator at " A " measures the distance between the two groups of pulses seen on his oscilloscope. Since the sweep rate of the oscilloscope is known, the velocity can be calculated. For the medium h.f. waves used, the velocity is considerably less than the velocity of light. AUTHORS.

5700. Linear Pulse Distortion in Recording Ionosphere Heights. H. Baerwald. *Techn. Phys., U.S.S.R.* 3. 7. *pp.* 604–632, 1936. *In English.*—The distortion of short pulses as used in ionospheric work, in a circuit containing the coil system of a " kinescope," is investigated. By comparing the Fourier spectra of different functions suitable for pulse representation, it is shown that distortion does not depend substantially on the special pulse shape when imposing certain limitations. Distortion can be reduced considerably by a shunt condenser of suitable size, without imparing directional sensitivity. Certain quantities are defined which characterise pulse attenuation and delay as well as the asymmetry and broadening effects of pulse distortion. These quantities can be written in terms of pulse duration and circuit time-constant and decrement. This leads to a simple method of circuit design for prescribed distortion limits. With suitable generalisations, the quantities just mentioned are suitable for the description of a general type of electrical network which has a wide field of technical application. The paper is almost wholly mathematical and is fully documented. J. E. B.

5701. Ionosphere Layers and Eclipse of the Sun. G. Leithäuser and B. Beckmann. *Zeits. f. techn. Physik,* 17. 10. *pp.* 327–329, 1936.—The impulse method was used to investigate ionosphere ionisation during an eclipse of the sun. After maximum occultation has been reached it might be expected that an ionisation increase would occur, leading to still greater ionisation values than before the eclipse, but after passing the maximum the increase of ionisation observed was only small and after this there was a very rapid decrease. Discussion of the results leads to the conclusion that the ionosphere has little to do with the rotation of the earth. It also appears that the ionisation of the upper layers is principally due to electrons not produced by the sun's light but originating from the sun. A. W.

5702. Propagation of Atmospheric Disturbances and Reception of Distant Stations during a Solar Eclipse. G. Leithäuser and W. Menzel. *Zeits. f. techn. Physik,* 17. 10. *pp.* 330–332, 1936.—On the assumption that the ionosphere is stationary relative to the earth's axis or that its motion relative thereto is only small, it is shown that the propagation phenomena concerned in the reception of atmospheric disturbances in the wave-band round 32 m. can be explained satisfactorily. Observations regarding the reception of oversea stations in this wave-band during the solar eclipse of June 19, 1936, are also found to be in agreement with the above assumption. A brief analysis of the observations is given. Of particular interest is the slow recovery of ionisation in the regions affected by the eclipse. A. W.

5703. Wireless Waves Reflected From the Ionosphere at Oblique Incidence. F. T. Farmer and J. A. Ratcliffe. *Phys. Soc., Proc.* 48. *pp.* 839–849, *Nov.* 1, 1936.—The waves emitted by a pulse transmitter at Cambridge were simultaneously received at a point distant 1 km. and at Edinburgh distant 464 km. in a direction 15° west of magnetic north. The variation of equivalent path with emitted frequency was studied for waves of such a frequency that they nearly penetrated the *F*-region. The results agreed qualitatively with a simplified theory, and under certain conditions showed the possibility of two transmission paths to the distant point. A quantitative discrepancy between the simple theory and experiment was noticed and its possible explanations are discussed. It is shown that by comparing the frequencies which just penetrate the *E*-region at normal and oblique incidence it might be possible to decide whether the Lorentz polarisation term should be included in calculating the force on an electron in the ionosphere. Experiments made for this purpose provided only a statistical result on account of the variable nature of the *E*-region. Measurement of the sunrise increase of absorption for waves received at the two points indicated that the day-time absorption takes place in a region below the main deviating portion of the *E*-region, for echoes both from the *E*- and from the *F*-region. AUTHORS.

***5704. Thyratron Voltage Control. C. J. Burbank.** *Rev. Sci. Instruments.* 7, *pp.* 427–429, *Nov.,* 1936.—A voltage control device for maintaining a constant high voltage for X-ray research is described. The control operates on the l.v. input to the h.v. transformer and varies the field current of the alternator to attain constant high voltage with varying alternator speeds. The circuit uses a thyratron as the current controlling device and a bridge of carbon-filament and tungsten-filament lamps to actuate the grid of the thyratron. A tuned circuit is incorporated to compensate for changes in filter efficiency with frequency. A circuit diagram and practical operating details are given. A. W.

See also Abstracts 5576, 5696.

PHOTOELECTRICITY.

5705. Photoelectric Properties of Barium and Calcium. N. C. Jamison and R. J. Cashman. *Phys. Rev.* 50. *pp.* 624–631, *Oct.* 1, 1936. —With a photoelectric cell in which Ba was fractionated and repeatedly distilled, values of ϕ_0 at room-temperature as obtained by Fowler's method, were found to be 2·520 and 2·510 eV, the difference being attributed to either differences in crystal structure or chemical purity. For both conditions of the surface, the cell showed extraordinary constancy of work function. Measurements 100° C. above room-temperature yielded a temperature coefficient of $(2{\cdot}2 \pm 0{\cdot}7) \times 10^{-5}$ eV/°K. The absolute photoelectric yield of the surface was determined. The optical reflection coefficient was found to vary from 43 % at 4000 Å to 63 % at 7000 Å. The work function of a Ca surface prepared by single distillation was 2·706 eV. After repeatedly heating the surface to 100° C. the data did not fit Fowler's theoretical curve. The departures were consistent with the assumption that, after heating, the surface was not homogeneous. Analysis of the data gave evidence of two emitting surfaces having work functions differing by approximately 0·2 eV. AUTHORS.

5706. Electrical Observations Relating to the Optical Formation of Colour-Centres in KBr and KCl Crystals. G. Glaser. *Ann. d. Physik*, 27. 3. *pp.* 217–232, *Oct.*, 1936.—It is shown that the photochemical formation of colour-centres in KBr and KCl crystals, which have been sensitised by the presence of U-centres or chemically, is not accompanied by any measurable electric current. This is shown by the fact that the spectral distribution of the photoelectric current produced during the photochemical formation of the colour-centres does not correspond with the optical absorption curve for the photochemically active radiation. The photoelectric current is considered to arise from hitherto unknown centres, designated X-centres. The optical absorption curve of these centres is similar in form to the long-wave end of the characteristic absorption of the "pure" crystal. Their origin is therefore attributed to impurity molecules. D. H. F.

5707. Primary Photoelectric Current in KBr Crystals in Alternating Field. A. Naumann. *Ann. d. Physik*, 27. 3. *pp.* 233–242, *Oct.*, 1936.—The photoelectric specific conductivity of KBr crystals containing colour-centres was found to increase with the frequency of an alternating applied field, finally reaching a saturation value. The admissible light intensity and the observed currents can be 1000 times as great as is possible in a static field. The conductivity corresponding to a given amount of absorbed radiant energy is the same in the alternating field as in the static field. The crystals are actually compacts of small crystals, and it might therefore be expected that the mobility of the liberated electrons would be hindered at the surfaces of the individual crystals, but from these observations, combined with the validity of Ohm's law, it is deduced that no such hindrance occurs. D. H. F.

5708. Photoelectric Phenomena at Boundary Surfaces of Semi-Conductors. G. Liandrat. *Ann. d. Physique*, 6. *pp.* 391–454, *Oct.*, 1936.—From a consideration of existing knowledge, and of experiments here described, the author contends that the behaviour of the "rectifier" photo-cell can be fully accounted for as follows. Photoelectrons traverse the blocking-layer with a kinetic energy of which the maximum value accords with the Einstein relation. They proceed from the semi-conductor; the yield is high since electrons liberated quite deeply in the semi-conductor can reach the surface without much energy loss. The secondary modifications of the conductivity of the blocking-layer are explained by the presence of electrons stopped there by the opposing electric field which is built up. It is not possible to account for the effect by a direct primary inner photoelectric effect arising in the blocking-layer. The augmentation of the photo-emission under an accelerating field is probably due to a diminution of the work function, more or less analogous to the Schottky effect. D. H. F.

5709. Photovoltaic Effect for Sodium. R. B. Gibney and M. Dole. *J. Chem. Phys.* 4. *pp.* 653–657, *Oct.*, 1936.—Attempts to produce a photovoltaic effect with reversible electrodes made of an active metal photoelectrically sensitive to visible light, such as Na, and dipping into a solution containing ions of the metal, met with no success provided the solvent and salt which formed the electrolyte were carefully dried before preparing the cells. Slight photovoltaic effects of the order of 0·5 mV or smaller were observed in the case of two cells known to contain traces of water, but these effects were probably due either to the water present or to the compound electrode Na/Na_2O rather than to the pure metal. It is concluded that the energy supplied to the electrons by the visible light is not sufficient to bring about the transition of the electron from the metal to the solution. AUTHORS.

*5710. **Frequency Characteristics of Rectifier Photo-Cells. F. W. Gundlach.** *Arch. f. Elektrot.* 30. *pp.* 625–637, *Oct.* 15, 1936.—By compensating the rectifier cell output with the output from an emission cell under illumination of the same periodicity, observations, independent of the frequency characteristics of the amplifier, were obtained up to 4000~. The frequency characteristics, as well as the light-response, are improved by the superposition of direct current in the barrier direction. This is explained in terms of the effect of the passage of the direct current on the resistance of the blocking-layer in the barrier direction, and on its capacity. D. H. F.

5711. **" Ballistic " Measurement of Selenium Rectifier Photo-Cell Currents. H. König.** *Helv. Phys. Acta*, 9. 7. *pp.* 602–610, 1936. *In German.*—Se rectifier cell currents are measured by observing the galvanometer throw when the cell is illuminated, the galvanometer being slightly underdamped. It is claimed that by this method reproducible intensity comparisons, independent of the immediately previous history of the cell, can be obtained. Measurements were made in this way on the intensity-current characteristic, and of the currents obtained when intensities of different wave-lengths are superposed. D. H. F.

*5712. **Determining Probability Curves by Photoelectric Integration of Light Impulses. I. J. Saxl.** *Rev. Sci. Instruments*, 7. *pp.* 429–432, *Nov.*, 1936.—A photoelectric device has been developed with which it is possible to measure automatically the relative times of exposure of a photo-cell placed in the path of a moving beam of light. When the photo-cell is illuminated, a relay is energised which closes contacts for an electrical stop-watch. Accordingly, this clock runs only when the beam of light is projected upon the photo-cell. By adjusting the position of this cell upon a graduated upright or within a predetermined area, it is possible to determine by the stop-watch reading the time of the photo-cell exposure to the illumination at a given location. Frequency distribution curves obtained in this manner were analysed and have been found valuable in the analyses of filamentous materials such as textile yarns. AUTHOR.

See also Abstracts 5352, 5532.

PIEZOELECTRICITY.

5713. **Oscillations of Hollow Quartz Cylinders Cut along the Optic Axis. Ny Tsi-Zé, Tsien Ling-Chao and Fang Sun-Hung.** *I.R.E., Proc.* 24. *pp.* 1484–1494, *Nov.*, 1936.—Hollow quartz cylinders cut along the optic axis have been excited to vibrate at 5 fundamental frequencies, corresponding to radial, circumferential, longitudinal, torsional and transverse vibrations. Empirical relations connecting the dimensions of the cylinders and the frequencies of the different modes of vibrations are formulated. All of these modes of vibrations have been confirmed by examination under polarised light and with lycopodium powder. AUTHORS.

See also Abstract 5628.

THERMIONICS.

5714. Irregularities in Thermionic Emission from Tungsten. F. L. Yerzley. *Phys. Rev.* 50. *pp.* 610–616, *Oct.* 1, 1936.—A tube employing a moving electrode is used to investigate variations in emission density over the length of a straight tungsten filament. After a critical temperature range is exceeded positive ion emission is shown to be limited to narrow regions near the lead wire connections. Electron emission, even after the filament is carefully aged, is not uniform from point to point, but occurs in a stable though irregular pattern. The irregularity is attributed to differences in work function or to differences in actual area covered by the slit or to a combination of both. AUTHOR.

5715. Positive and Negative Thermionic Emission from Tungsten. H. B. Wahlin and L. V. Whitney. *Phys. Rev.* 50. *pp.* 735–738, *Oct.* 15, 1936.—The positive and negative thermionic emission and the rate of evaporation of neutral atoms are studied for well outgassed W. To fix a reliable temperature scale the spectral emissivity for $\lambda = 0{\cdot}669\ \mu$ is determined for a cylinder heated in a vacuum. The emissivity is found to be a constant and equal to 0·46 from 1200° K.–2200° K. A determination of the heat of evaporation of neutral atoms gave a value of 8·44 eV. The electron work function is found to be 4·55 eV with an A of 75 A/cm.^{2}/degree^2 until the filament is heated to a temperature of 3100° K., after which the work function is 4·63 eV and the value of A is 212. The average positive ion work function is 11·93 eV. This value closes the thermionic cycle if Russell's value of 8·1 for the ionisation potential is used. AUTHORS.

See also Abstract 5650.

THERMOELECTRICITY.

5716. Thermoelectric Power of Bismuth Crystals in Transverse Magnetic Fields. E. Grüneisen and J. Gielessen. *Ann. d. Physik*, 27. 3. *pp.* 243–255, *Oct.*, 1936.—Using the same experimental arrangement [see Abstract 3877 (1936)] measurements are made on the differential thermoelectric power of constantan/Bi and $\mathrm{Bi}_{\perp}/\mathrm{Bi}_{\parallel}$ between 0° C. and − 195° C. in the absence of a magnetic field and also in transverse magnetic fields up to 6100 Oe. Both magnetic field and temperature appear to exert considerable influence on the thermoelectric power and the results are given in a series of tables and graphs. No relationship is detected between the variation of thermoelectric power and resistance, apart from that due to the symmetry of the crystal. R. L.

See also Abstract 5689.